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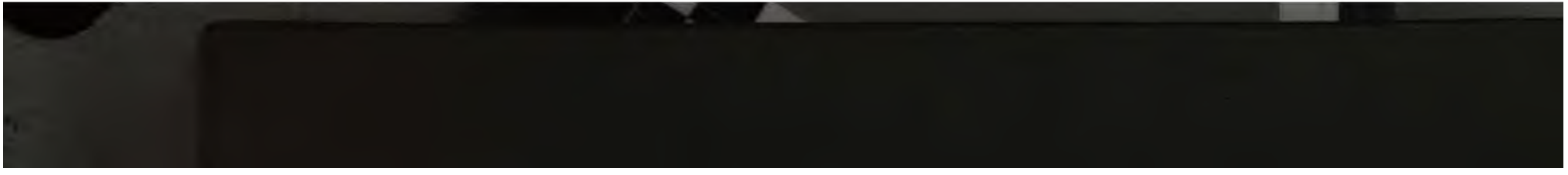

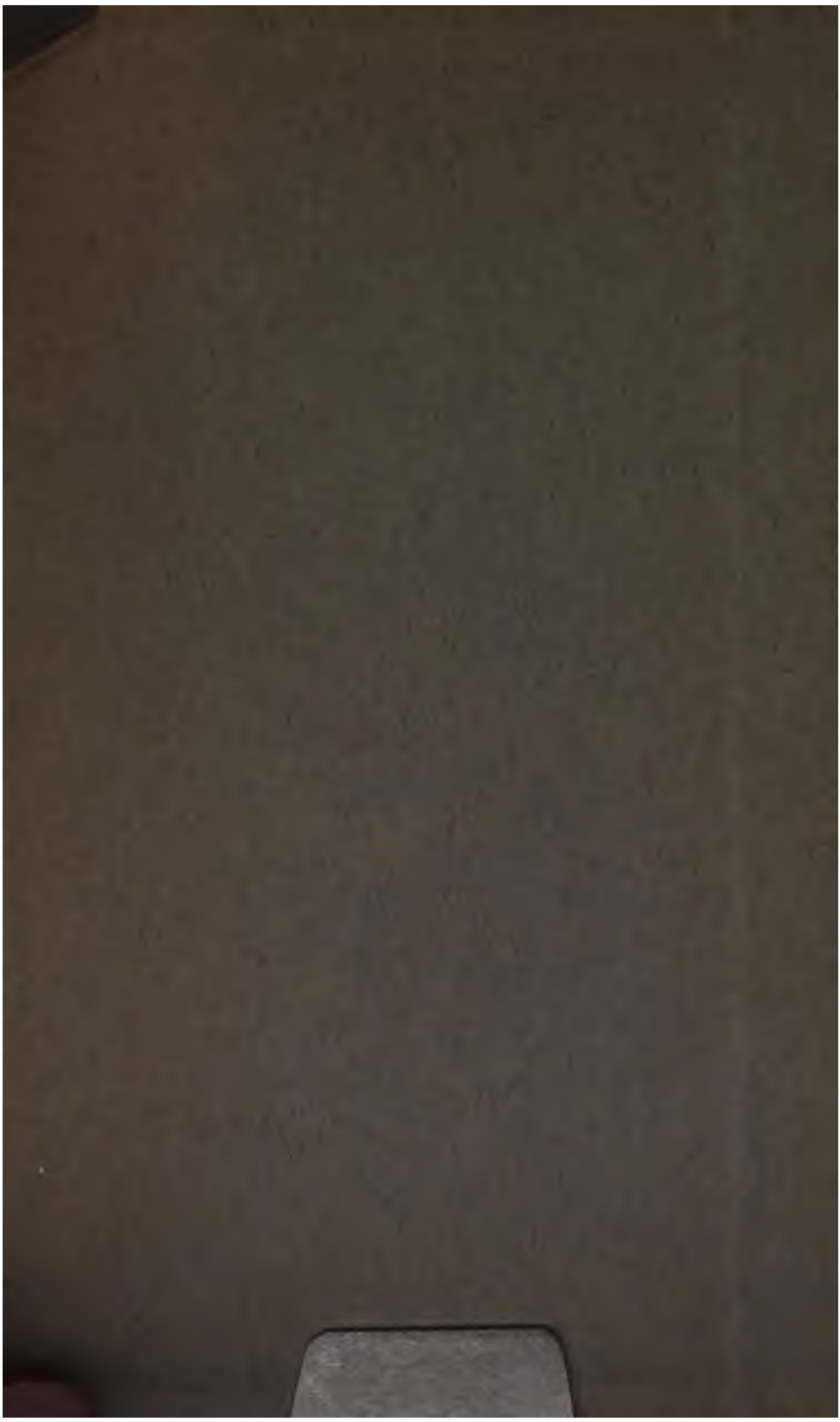

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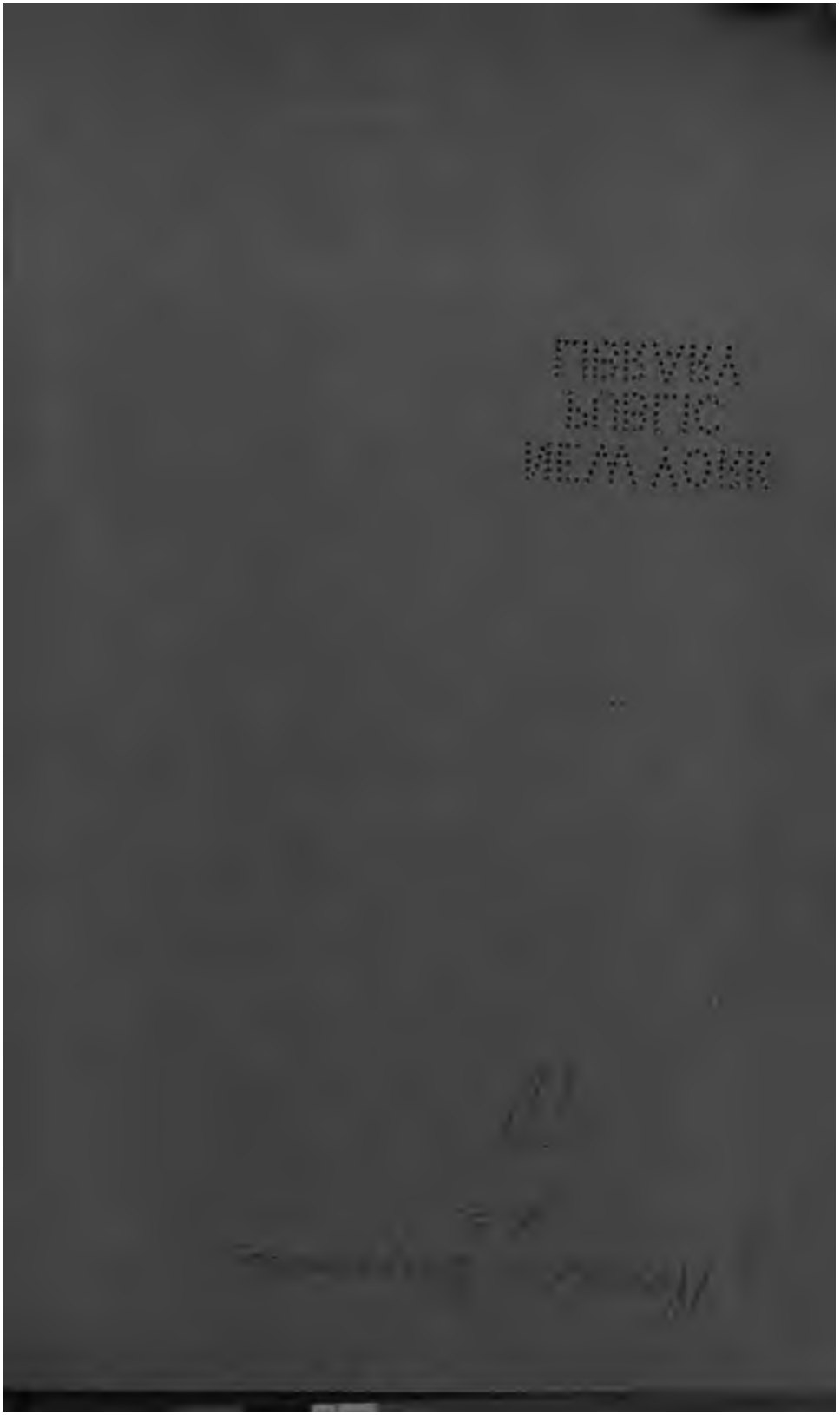

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TABLE OF CONTENTS

Adaptability of Merit System to the Engineering Service 98
Address of George C. Diehl 24
Address of President Fletcher 10
Address of Judge Nat E. Harris 323
Address of S. Percy Hooker 34
Address of Robert N. Hooper 15
Address of Joseph W. Hunter 128
Address of Clarence Kenyon 41
Address of James H. MacDonald 170
Address of Logan Waller Page 342
Address of Joseph Hyde Pratt 37
Address of Senator Hoke Smith 17
Address of Col. Sidney Suggs 22
Address of Leonard Tufts 21
American Automobile Association 4
American Highway Association 4
Annual Meeting of American Highway Association 356
Bishop Candler 7
Bituminous Macadam by Cold Mixing Method 253
Committee on Resolutions 46
Convict Labor 268
Convict Labor in Colorado 273
Drainage Structures 142
Educational Campaign for Good Roads 316
Educational Field For Highway Departments 64
Efficiency of Highway Organization 51
Engineering Supervision of Road Construction 110
Extent to Which Engineering Schools Give Attention to Highway Engineering Instruction 76
Grades and Excavations 145
Governor Slaton 8
Heavy Traffic Roads 175
Highway Engineering Education 305
How to Take the Roads Out of Politics 81
Hydrated Lime in Road Construction 180
Maintenance of Earth Roads 193
Officers 3
Possible Lines of Improvement in Highway Contract Work 294
National Legislation for Good Roads 29
Report of Legislative Committee and Discussion 46
Resolutions Adopted 47
Rights of Way 131
Road Economics 58
Road Maintenance 200
Road Work by the Army 286
Roy, William R 154
Selecting Roads to be Improved 171
Simplified System of Town Highway Accounts 56
Sound Administration of Public Service 91
Speare, Lewis R 27
State Control of Road Construction 117
Street Construction and Maintenance 337
Surfaces for Light Volume Mixed Traffic 157
System in Road Management 230
Women's Conference on Roads 337
Woodward, Mayor 9
Why Georgia Builds Top Soil Roads 329

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TABLE OF CONTENTS

Adaptability of Merit System to the Engineering Service 98
Address of George C. Diehl 24
Address of President Fletcher 10
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Address of Joseph Hyde Pratt 37
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Address of Col. Sidney Suggs 22
Address of Leonard Tufts 21
American Automobile Association 4
American Highway Association 4
Annual Meeting of American Highway Association 356
Bishop Candler 7
Bituminous Macadam by Cold Mixing Method 253
Committee on Resolutions 46
Convict Labor 268
Convict Labor in Colorado 273
Drainage Structures 142
Educational Campaign for Good Roads 316
Educational Field For Highway Departments 64
Efficiency of Highway Organization 51
Engineering Supervision of Road Construction 110
Extent to Which Engineering Schools Give Attention to Highway Engineering Instruction 76
Grades and Excavations 145
Governor Slaton 8
Heavy Traffic Roads 175
Highway Engineering Education 305
How to Take the Roads Out of Politics 81
Hydrated Lime in Road Construction 180
Maintenance of Earth Roads 193
Officers 3
Possible Lines of Improvement in Highway Contract Work 294
National Legislation for Good Roads 29
Report of Legislative Committee and Discussion 46
Resolutions Adopted 47
Rights of Way 131
Road Economics 58
Road Maintenance 200
Road Work by the Army 286
Roy, William R. 154
Selecting Roads to be Improved 171
Simplified System of Town Highway Accounts 56
Sound Administration of Public Service 91
Speare, Lewis R. 27
State Control of Road Construction 117
Street Construction and Maintenance 337
Surfaces for Light Volume Mixed Traffic 157
System in Road Management 230
Women's Conference on Roads 337
Woodward, Mayor 9
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FOURTH AMERICAN ROAD CONGRESS

HELD UNDER THE AUSPICES OF

AMERICAN HIGHWAY ASSOCIATION
AMERICAN AUTOMOBILE ASSOCIATION
COUNTY COMMISSIONERS ASSOCIATION OF GEORGIA

ATLANTA, GEORGIA

November 9th, 1914, 10 A.M.

PRESIDENT A. B. FLETCHER IN THE CHAIR

THE PRESIDENT: The Convention will please come to order. I have the honor to introduce the Right Reverend W. A. Candler, Bishop of Georgia.

DR. CANDLER: Let us pray: Our Father in Heaven we worship Thee as the Father of our Lord Jesus Christ from Whom cometh every good and perfect gift. We are grateful for Thy goodness unto us. Thou hast not dealt so with any other people. Thy providence has been over our nation through all the years as a very pillar of cloud and of fire. We thank Thee that our people are at peace, that the rude cries of war are not heard nor is there lamentations in our streets because they come not back who have gone in to the conflict. Thou hast given us abundant resources of every sort. We pray Thee to bless us with grateful hearts and faithful spirits that we may fulfill the mission set before us by the divine providence over us. Bless this assembly of men here met to consider a great interest that affects the social and moral and material welfare of our people; and the blessing of Almighty God be upon them individually and collectively that wisdom may characterize their conclusions and harmony their proceedings and that good may come to our land and as we affect other lands, to all lands through this meeting. God be merciful unto us and bless us and cause His face to shine upon us, that His name be known in the earth, his saving health among all people. We remember this day to pray for the stricken and disturbed peoples grappling with one another in contest of war. Oh Thou Prince of Peace, calm this combat, bind up the broken hearted and subdue the passions of men and let good prevail over all evil. Guide us by Thy counsel whilst we live and afterwards receive us into glory through Jesus Christ, our Lord. Amen.

THE CHAIRMAN: I have the very great honor to present to you the Hon. John M. Slaton, Governor of California. (Laughter) —I mean Georgia.

GOVERNOR SLATON: *Ladies and Gentlemen:* I suppose it was designed when the President introduced me as the Governor of California. The idea is that if we have good roads, all distances will be annihilated; California will be about as close to Atlanta as some parts of Georgia. The truth is that one of the benefits of good roads is this unification of the people and the introduction of them to each other. It is particularly appropriate that you should meet in Georgia. You understand that in 1834 the State of Georgia built the first State constructed railroad and it still owns it, a railroad between Atlanta and Chattanooga; and a railroad is nothing in the world but the evolution of a good road. We recognized the effect of transportation upon the welfare of the people and therefore we appropriated the money at a time when the people were in hard straits, in order to accomplish the purposes for which you have met. Now we all are acquainted with the benefit, in a general way, of good roads. We understand the effect upon the schoolhouse and upon the church and upon rural life; we understand that it relieves the farmer of his burden of transportation, that it aids in the construction of homes in communities where Nature can be enjoyed and where congested communities may be relieved, but we are glad to have you because you come for a practical purpose. You are with us to instruct us. There was a proud old house in Europe whose motto was "I serve," and you gentlemen and ladies have come here in order to serve the State of Georgia. Our State is alive to the purpose for which you are organized. We appropriated in 1911 $4,500,000 for the purpose of good roads. This includes, of course, the service of the convicts upon the roads, and we utilize them for that purpose and find that it is in accordance with wise penology as well as producing a return to the people for the expense which these criminals occasion. But there are problems that come before us as to the construction of roads. What we need now are not platitudes but specific advice. Problems are coming before us constantly as to the construction of roads—the engineering questions which arise—the question of upkeep, the question of materials from which they could be constructed; and therefore to you gentlemen we look. You represent the highest and most trained intelligence in the United States upon the subject to enlighten us. You will find that all over Georgia there are County Commissioners and those who have the matter of construction of roads in charge who will be present and listen to what you all have to say, and when you are gone the seed you have sown will serve to benefit the State and its people. This idea of service is that which is abroad everywhere. I read the other day that the Japanese conquered Russia not by the valor and gallantry

of their soldiers but by the skill and capacity of their engineers, and the battle was won by shooting over mountain tops by those who had calculated with the theodolite and knew the measure of the angle. You gentlemen, therefore, and ladies, have come to give us that information and when you have gone the effect of your visit will be remembered, not only for the social influence you have exerted, but because of the information you have left. Allow me to say that the people of Georgia are a kindly and generous people and in their behalf I welcome you into our midst. When you shall have left, I hope you will carry with you the kindest recollections of a people in whose behalf I welcome you.

THE CHAIRMAN: I take pleasure in introducing the Honorable James A. Woodward, Mayor of Atlanta.

MAYOR WOODWARD: Mr. President, members and visitors of the Fourth American Road Congress: It is always a pleasure rather than a duty placed upon the Mayor and the Governor of the State and city to give expression to words of welcome. I know that so far as Atlanta is concerned, it needs no words from me to tell you that you are welcome to this city. You are, and we are glad to have you. We want you to feel while here that the latch string of every door is open to you; if you don't see what you want, ask for it and it will be shown you. You are within the walls of a city that is somewhat remarkable. Take the life of it; there are few American cities that can come anywhere near to what it has accomplished. I do not refer to it in any spirit of alluding to war times, but take it from that time on. There was then possibly only ten or twelve thousand inhabitants in Atlanta. It reminds me—for I was here right after that fateful period—of what I read about what is going on in the old country now, the towns and cities that are being devastated. That was the condition of Atlanta at that time. People had come home without a dollar to invest but with all the desires and pluck and energy to build up their homes in a devastated country; and went to work. So you can see that Atlanta is really a city of about 40 years, and take all of its actual life since it was in the woods and it is in the span of a man's lifetime of three score and ten; but Atlanta as you see it today has grown within the last 20 or 25 years, even within the last 15 years. Fifteen years ago there was not an office building here except the Equitable Building. They have all been built within that time. Atlanta prides herself on being a city of more fireproof buildings—office skyscraping buildings—than any city of twice its size within the confines of the American continent. I imagine that a good many of you people who have come here from the west and the north, when you get into our streets, thought something of home. Now for the past 25 years we have given a great deal of time and a great deal of money has been expended in street buildings. I have not the exact figures with me

now, but I should say that Atlanta has close to 200 miles of paved streets. The leadway that Atlanta has taken in such measures as that has gone a long way toward encouraging the people in the country to build good roads, and as the Governor has well said, within the past few years they have turned the convicts from the lease system to that of appropriating them to the different counties for the purpose of building roads, and there is no one thing that I can call to mind that will do more toward the upbuilding of our country than the building of good roads. To the truth of what I have spoken to you as regards Atlanta and Fulton County, our County Commissioner will show you before you leave here. We are well provided—while we have not got enough—yet with good roads in Fulton County. You have got a convention here that is not only an educational one to our people in Atlanta, but to people from all over the country. You come here largely—one element at least—to display your road making machinery. The delegates to this convention have come here to investigate and satisfy themselves and see for themselves what class of machinery will aid them best in their work. It was quite appropriate for you to meet at this time in the gate city of the South, where possibly the building of good roads and the advancement of good road machinery is more necessary. It has been said that the advent of the automobile created extravagance, and possibly that is true in one line, but we must all admit that the automobile showed us the necessity for good roads; [applause] and in that manner was a blessing to the country and to humanity. Now in conclusion allow me to say that Atlanta extends to you a most gracious welcome. We are glad to have you within our city. We want your stay to be as pleasant as it can be made, and when the time comes for you to depart, we want it arranged in such measure that you will go away from Atlanta with a kind word, a good taste in your mouth for this city and may that all wise Being who is overlooking those loved ones you have left at home, preserve them in their good health until you return. Before I take my seat, I would like to inform all of the municipal people here—while we appreciate everybody that is in attendance on this convention—that the City Government desires that they register at the City Hall. We wish to meet you and give you what attention we can.

Mr. Page takes the chair.

THE CHAIRMAN: Next on the program is the response by President Fletcher.

PRESIDENT FLETCHER: *Mr. Chairman and Gentlemen:* The warmth of our welcome, the refreshing completeness of all the measures that have been taken for our comfort and the spirit of enthusiasm displayed by this great gathering of good roads workers makes us all from north, south, east and west glad that we are here. To His Excellency the Governor of Georgia and to his

Honor the Mayor of Atlanta, I desire to express, on behalf of the delegates and visitors to the American Road Congress, their deep appreciation of this magnificent welcome. To those of you who are attending the American Road Congress for the first time, it may be of interest to hear a word or two as to why this great national road meeting has become an established institution and a necessary factor in the working of the fundamental problem of road improvement. Interdependence of city and country, of producer, of shipper, of consumer, has developed to such a degree that the public road once of local importance has become of state wide and in many instances of interstate importance. This necessitates a readjustment of the burdens of cost, a recasting of the regulations of traffic while all this great passenger and freight traffic that now weaves in and out on this network of roads, has produced conditions of wear and introduced agencies of destruction which make new and difficult problems of construction and maintenance for the engineer to solve. We are here therefore to discuss and devise better legislation, better systems of finance, better traffic regulations; to learn by discussion and exchange of experience of the types and of the methods of roads which are best adapted to meet the conditions of traffic which confront the highway engineer. We are here to urge that the time has come to take the public road out of politics, to handle it as we would a great business undertaking, and to urge the creation and development of a nation-wide corps of trained and efficient men who will make road building and maintenance their life work. Gentlemen, you will hear these great questions discussed in detail at the various sessions of the Congress and I merely mention them at this time in the hope that you will take the proceedings of this Congress most seriously and devote every faculty of mind and heart toward making this year's Congress useful to the American people in the highest degree.

President Fletcher takes the Chair.

THE CHAIRMAN: I have the honor to introduce to you the Honorable Logan Waller Page, Director of the United States Office of Public Roads and President of the American Highway Association.

Mr. President and Gentlemen: The fact that men eminent in the good roads movement are here from the far off Pacific Coast, from the Northwest, from New England and in fact from nearly all of the forty-eight states of the Union, demonstrates conclusively that the question of road improvement is no longer of merely local significance. It is proof that this great question is of nation wide importance, and well it may be so considered, for it touches human welfare at every angle and is a material factor in the development of education, in our home life and in religion, the three great fundamentals of our civilization.

You will hear during the sessions of this Congress the experience

and the advice of the best known specialists on every phase of this great subject. I shall confine my remarks therefore to a few comments on what has been done to further the road movement during the past year, and along what lines we may hope for results during the year 1915.

The Office of Public Roads, has an organized corps of collaborators composed of one representative at each State capital who makes monthly reports to the Office showing what has been accomplished in the State and what measures are contemplated or pending. Through this source of information we have ascertained that the year 1914 has added to our mileage of hard surfaced roads a total of 18,000 miles, which means that in the short space of twelve months we shall have added to our road system a mileage three-fourths as great as the total length of the National Roads of France.

We are spending money on our roads with a rather free hand. Last year our total outlay, in money and labor, was in excess of $205,000,000, and I think we are safe in saying that the aggregate will reach $225,000,000 this year, or more than an average of $100 per mile for every mile of highway throughout the United States. This average looms up as a rather impressive figure when I say that according to the best information available 20 per cent of the roads in an average county carry 80 per cent of the traffic. This great annual expenditure, therefore, if pro rated on the basis of the really important roads gives an average of something like $500 per mile per annum.

Our system of road management is admittedly wasteful and inefficient except for the few shining exceptions here and there, and I firmly believe that with good business methods and skillful supervision we could save not less than $50,000,000 per year and obtain better results than we are now obtaining.

An exceedingly important factor which has come into prominence in solving our road problems during the past ten years is that of convict labor. Many of the States are using their convicts in the building of roads and in the preparation of road materials, and I congratulate the State of Georgia on her lead of all States in this respect, for Georgia, I understand, now has a great road-working army of more than 5,000 convicts which are rapidly transforming the road system of the State. We have estimated that the total convict labor days on road work throughout the United States in 1914 will exceed 3,000,000.

As indicating the trend of this movement I may say that during the year the States of Ohio, New York, Wisconsin and West Virginia have authorized the use of convicts in this way, thus indicating that this policy has no geographical bounds to its field of usefulness.

I wish particularly to call your attention to the work of the United States Office of Public Roads, not from any desire to boast of the results which we have accomplished but in order that you may

understand the way in which this service of the government may be utilized to help your own local problem, if you need such help as the government may give.

During the past ten years our engineers have supervised in all parts of the country the building of what we term Object Lesson Roads for the purpose of giving to the local officials direct instructions and advice on the best methods of construction. Recently we have found that an even more important problem is that of maintenance, for the practice is all too common of building excellent roads and then leaving them to disintegrate under the action of weather and traffic. Probably the most striking demonstration in proper methods of maintenance which has ever been undertaken as an Object Lesson was inaugurated by the Office of Public Roads last March at the suggestion and in coöperation with the American Highway Association.

Sections of road forming a continuous stretch in twenty-eight out of forty-nine counties between Washington and Atlanta have been voluntarily placed under the direction of government engineers by the county authorities and cash appropriations made for expenditure in such manner as these government engineers may direct.

To facilitate the work and to permit the engineers to cover a relatively large territory, the American Highway Association supplied without cost to the government or the counties, three automobiles. I think I am perfectly justified in saying that the improvement on these roads has equalled the most sanguine expectations of those who inaugurated the project.

I have mentioned these examples of government work to indicate to you the basis upon which the government's assistance is granted. There are many more projects under way designed to further the building and maintenance of good roads in accordance with sound economical principles and good engineering practice, and I wish to emphasize that all of the assistance which the government renders in this work is without any cost whatever to the local communities.

I shall not review the work of the American Highway Association during the past year, as this information will be given out in the various annual reports of the officers and committees of that organization; but I wish to comment most particularly upon a project which holds as great possibilities, in my judgment, for the betterment of road management as any one project which has ever been undertaken.

Last year at the Third American Road Congress a committee was appointed to take steps looking to a revision of State Road Laws. At the request of the committee the Office of Public Roads prepared a literal compilation of the Road Laws of each and every one of the forty-eight States, and the result is a huge accumulation of words exceeding 3,500,000 in number. This great manuscript is being cross-indexed and I understand that the committee will get in active touch with each State Legislature in an effort to bring about a

simplification and a revision of the Road Laws at the earliest possible moment. All that may be done along this line will be of lasting benefit and will be enough of itself to justify a continued support to this great organization.

Within the past few months steps have been taken towards bringing to the support of the road movement, the united efforts of women in every county and in every community throughout the United States. This work has taken definite form through the establishment of a women's department of the American Highway Association, with Mrs. Robert Baker, of Washington, as Chairman. The first conference under the auspices of this department will be held in the city of Atlanta tomorrow, and I am glad for the success of the movement that it is being launched here where it will profit by the wonderful Atlanta spirit of progress. I hope and believe that the women will accomplish marvelous results in bringing about through moral suasion an improvement of road conditions in rural communities, and in so doing help the cause of better schools, better churches and better homes.

I will not go into any detailed statement of the objects and working plan of the women's department, as this will be fully covered by addresses to be given later on in the week. I may say, however, that this work is designed to introduce particularly better road management and better maintenance of our public roads.

I know that it is customary for speakers to extol all the good qualities of the cities in which meetings are held; but I wish to say more than the usual words of appreciation of Atlanta's splendid hospitality and cordial spirit of coöperation. Not in my whole experience in attending conventions have I come in contact with a courtesy so all-pervading, with a spirit of helpful coöperation so timely and practical, and with a knowledge of what needs to be done, and the energy in doing it, such as has been displayed by Atlanta in connection with this Congress. The arrangements are complete to the most minute details, and I can now well understand the marvelous progress which Atlanta has made and what is meant when people speak of the "Atlanta Spirit."

In conclusion I wish to emphasize that the year of 1915 holds possibilities for progress in road betterment which we should avail ourselves of, not merely through zeal but through zeal coupled with knowledge. We have had ample opportunity to realize that we need better road legislation, and with so many legislatures in session this coming winter, we shall have the opportunity to accomplish results through revision and constructive road legislation. We have seen what has been accomplished in those sections of country which have utilized in a practical way skilled supervision of road work. We have learned to our bitter cost the danger of allowing our well constructed roads to be left to deteriorate through lack of maintenance, and so we should make the year 1915 conspicuous; not so much through the spending of more money as through the

wise and practical expenditure of the money that will be normally available.

I might add that today you can go on a splendid road from Atlanta to Fredericksburg, Va., within 40 miles of Washington, and by next summer, you will be able to go from Atlanta to Richmond, Washington, Baltimore, Philadelphia, New York, Boston or Montreal on a perfect road, and that road is going to be maintained as such.

THE CHAIRMAN: The Governor, who was obliged to leave a few moments ago, has asked me to call your attention to the reception given by Governor and Mrs. Slaton to-night at 8 o'clock, and to extend you a cordial invitation to be present. I have also been asked to announce that there will be a Woman's Conference on Roads in the ballroom of the Ansley Hotel at 10 o'clock and at 2 o'clock to-morrow, Tuesday. There will be addresses by distinguished women and an illustrated lecture by Mr. J. E. Pennybacker. All women are cordially invited.

Mr. Robert P. Hooper former President of the American Automobile Association will now address us.

MR. HOOPER: I am taking the place of our absent president of the national organization of automobilists, who regretted exceedingly his inability to be present. My previous automobile visit to your hospitable city was during the big tour from New York to Jacksonville via Atlanta. Senator Hoke Smith, then your Governor, easily was the central figure of that tour, and repeatedly in various cities he spoke without hesitation for roads progress, as the head of your State. Now, in the Senate of the United States, he has opportunity to use his great influence in a logical and effective plan of Federal roads participation.

Roads improvement in Georgia is certainly proceeding in a most pronounced manner, and the day is near at hand when it will be just as comfortable to travel by road in Southern territory as is now the case in New England. Here is Fulton County, you have made a wonderful advance in roads construction, and furthermore, you give evidence that it is clear to you that the most used roads must be constructed in such manner as to stand the multiplying and heavier traffic.

You are particularly fortunate in Georgia in having in Governor Slaton another chief executive who is not afraid to set forth quite plainly his good roads beliefs, and I thank him for the unhesitating manner in which he gives deserved credit to the motor-driven vehicle for the large part which it has played in this improvement of the avenues of communication.

In brief, the A. A. A. believes that the Federal government should help the several States on their most important arteries of communi-

cation, and then the States can coöperate more thoroughly with the county and township units in the essential lateral roads.

It was my opportunity to have been the first active chairman of the A. A. A. National Good Roads Board. You will pardon me if I make reference to a speech delivered by me at Springfield, Massachusetts, in September, 1907, at the Goods Roads and Legislative Convention called by that club and possessing the motto of "Good Roads and the Sane Use of Them." In that convention certain speakers went out of their way to belittle the participation of the motorists in highway progress. I confess that I rather impatiently accepted this kind of talk until it came my turn to speak. This, briefly, is what I found myself saying: "I think it is time that someone told of what the autoists have done. The movement for good roads was begun by the bicyclists and has been taken up and advanced by the autoists. Our damage to the roads has been more than offset by the good work we have done in their behalf. I say that it is proper for the autoists to be compelled to obey the law; but we do object to the existing laws. Why should the automobilists pay a tax, when any wagon can draw any load over the same roads? I see no reason why the wagon drivers should not help to support these roads.

Perhaps we motorists at times become unduly optimistic, but I look forward to the day when we shall have highways connecting our several States the equal of those to be found in France. Furthermore, there will be an exchange of road travelers between the North and the South that will be beneficial and educational to both sections of the country. In no way can we become better acquainted than through the intimate channel of roads travel, for then we promptly discover that we are all only human beings, interdependent one upon the other, and equally interested in the general welfare of our great country.

When I came down South on this trip I expected to see before me a lot of men who were walking the streets of Atlanta in sackcloth and ashes. But instead of that, I hear you agreeing to spend money, and I hear you putting up propositions to build more roads. Therefore, we in the North cannot feel that you are as low in pocket as your "Buy a Bale of Cotton" movement would lead people all over the United States to believe. Frankly, I think it is a great mistake for my southern friends to circulate all over the country, this "Buy a Bale of Cotton" movement, indicating that you are financially broke, because you are not. We will give you credit, and we are glad to give you anything you want at any time.

THE CHAIRMAN: I am sorry to announce that the Hon. A. W. Campbell, Deputy Minister of Railways and Canals, Government of Canada, will not be with us this morning. It gives me great pleasure to introduce the Hon. Hoke Smith, United States Senator from Georgia.

SENATOR SMITH: *Mr. Chairman, Ladies and Gentlemen:* The first notice I had that I was expected to address you this morning was when, after breakfast, I read the morning paper, and found that I was on the program. I should have been very much disturbed by the announcement had I not seen the further statement that it was to be a general address, from which I understood that I was not expected to show in any way before you expert road builders, my ignorance of the subject of expert work in the construction of roads, but that I was permitted to talk generally about anything I want to talk about rather than upon technical road building.

I am deeply interested in your gathering and in your work, I agree with my friend who has just taken his seat, that we had rather an overdrawn picture of the great public highway that stretches from here to Fredericksburg, and will soon stretch from Fredericksburg to Canada. I agree with him that it is well paved with good intentions, but unfortunately with nothing else. Now, just a word about the "Buy a Bale of Cotton" movement. I wish to say that if any one came here expecting to see a poverty stricken section, he was vastly mistaken.

MR. HOOPER: I did not say that I did, Senator.

SENATOR SMITH: He has come to the greatest section in natural agricultural resources in the world, and I say that advisedly, and I will prove it with just two or three statements. In this section with proper attention, the soil per acre will produce as much foodstuffs as any soil that can be found anywhere. It begins equal in food producing capacity with any acreage in the world, then it furnishes to our nation a monopoly in the great raw material that must clothe the world.

From whatever section of our common country you may come, you should feel proud of the fact that our United States has a monopoly in the production of the raw material that is necessary to clothe the world.

They can raise in India a very short staple cotton, but they cannot make much out of it unless they mix our American cotton with it. They can raise in Egypt some very long staple and very fine cotton, but it is limited in its use, and it is our cotton, or cotton that is produced in our common country, that is absolutely essential to clothe the world and our cotton crop is growing more and more important every year for this nation. [Applause.]

I am deeply interested in the good roads problem; not exactly in the same way that my friend Mr. Hooper is. He always thinks of a great national highway to run his automobile over, and to have a splendid Glidden tour over. I am in favor of that kind of good roads, but the good road that interests me most is the good road that is to help build up that upon which our country rests for its prosperity more than any thing else. [Applause] Every country, ours

especially, rests for its wealth producing power upon agriculture and manufacture. Agriculture produces something. The mill adds to the value of the raw material by changing it into something of additional value. Commerce handles these products; the railroads transport them, but the wealth producing power of the nation is found in our agriculture and in our mills, and our manufacturing companies must rest upon our agriculture for their raw material as the people of the world must rest upon agriculture for their food. So I place first among the things that should receive the attention of a nation, the agriculture of a nation.

No nation ever lapsed, no nation ever went backwards while making progress in its agriculture. Now our manufacturing enterprises are ahead in world progress as compared to our agriculture. We rank with the best in manufacturing lines, but we are behind in agriculture. We do not produce per acre in agriculture what is produced in other countries. We have not studied agriculture scientifically as agriculture has been studied in other countries. We have not handled our soil with the consciousness of the fact that each year that which we took out of it we must put back with more to increase its strength and power. We have rather, through the richness of our soil, handled it with wastefulness and have each year been disposed to lessen the real resources of our soil rather than to add to it and increase it.

We have neglected the roads in our rural sections; we have left rural life isolated; we have left rural life where facilities to reach the schoolhouse have been lacking, where facility to reach the church has been lacking. We have left it where the people in rural sections ofttimes seek the town rather than live upon the farm because of the lack of opportunity, on account of bad roads, to pass from place to place.

I look upon the good road problem as preëminently a national service. Because it is to lessen the cost of transportation of agricultural products, and the cost of transportation to the farm of that which is needed on the farm, and because it is to take from rural life its isolation and help make rural life all it should be in its beauty and its charm.

I believe we have just begun a great national progress toward the development of the farm. Fifty years ago we established our national agricultural colleges through the Morrell Bill, giving the landscript in each State to an agricultural college. They struggled along until now in every State, supported by State taxation as well as by the Morrell landscript fund, we have I think in every State a splendid agricultural college.

Twenty-five years ago, we passed a bill to establish the experiment stations, and for 25 years we have had our agricultural colleges and our experiment stations. Vast stores of knowledge have been gathered in these two institutions, but they have been on cold storage, they have just been there undistributed. You cannot

carry that information to the farm and put it to work simply by circularizing those engaged on the farm.

Within the last 12 months, Congress has passed a bill for agricultural extension work. Starting with the first of this last July, each State received from the national government $10,000 for this purpose. The appropriation increases year by year until it reaches $6,000,000, each State beyond the $10,000 being required to duplicate from its own treasury what it receives from the national government, and all that is known in the experiment stations and the agricultural colleges is to be carried to the farm home and by demonstration on the farm, given for the use of every farmer. In our own country it has been tried to a limited extent. Dr. Knapp was the great leader of farm demonstration work in the United States, but he turned back to Germany for the highest character of work of this kind. Those wonderful people who today are standing off all of Europe, not by their numbers but by their training; those wonderful people 50 years ago realized the necessity of carrying accurate and scientific knowledge in agriculture to the farmer's home, and the Wonderlehrer and Wonderlehrerin, the traveling teacher of Germany, carried to the home of the farmer, through men and women, all of the scientific knowledge of the soil that the college could acquire and the experiment station demonstrate, and gave it with practical illustration alongside the farmer's home, upon the farmer's land, and the Wonderlehrerin of Germany, the woman, traveled from place to place and carried the knowledge of domestic science and of all those things which study and investigation could acquire, and gave it to the German woman on the farm.

Now our agriculture extension bill, passed last February inaugurates for our country a great system of instruction at the home of the farmer by which we expect to see the next 10 years revolutionize the productive strength of the soil of our country, and help to make the farm home more beautiful, more hygienic, more capable of developing splendid men and women, for after all, legislation and work in our country should place commerical progress far behind the problem of developing the men and women of our country.

We have added another measure, last January, a market bill it is called, and starting with the first of July, the Agricultural Department has $250,000 to be spent this year to organize the farmers for the study of the better preparation and the better marketing of their products, and for the study of the condition of the people in the cities that they may be brought in closer touch with the farmer and be prepared to get the benefit of the better marketing by the farm, to bring consumer and producer closer together, that the enormous economic waste that has been going on may be brought to an end.

Secretary Wilson, who for so many years made this country a great Secretary of Agriculture, said not long ago that for every 50 cents

the farmer got for what he raised, the ultimate consumer paid a dollar, and then he asked "What becomes of the other 50 cents?" An investigation of the question shows that but a small percentage of it goes to transportation and but a small percentage of it really has gone to the middle man; the bulk of it has been an economic waste, and we are seeking and will continue to seek to make a live part of the work of the National Agriculture Department the study of the problem of marketing, that the product of the farm may bring more to the producer and yet go to the ultimate consumer at a less cost than he pays today. That one-half waste can at least, half of it, be saved, and if a fourth of that went to the farmer and a fourth of it went to the consumer, splendid would be the improvement for both.

Then we have added a practical parcels post, progressive and developing, through which we furnish the means for the farmer and the man in the city, the ultimate consumer, to get closer together, and the merchant and the farmer, without waste, to get closer together. Those are three things that have been done for agriculture, another is lacking, it takes a fourth. The fourth is good roads.

Do not allow charming advocates of great national highways to sweep away from your minds the thought that the greatest of all good that can come from good roads is the development of the agriculture of our country.

Nobody likes his automobile better than I do, and nobody enjoys a great national highway or a Glidden tour more than I do, for I rode with our friend Mr. Hooper from New York through to Atlanta on one of those tours. They are splendid, but their chief value is that they may stimulate better roads away from the great highways. If we are to simply have the great highways and nothing more, I would give little for them as an economic force to develop the country, but as an inspiration to build feeders all around, and to have good roads every where, I recognize their value and I am thankful for them. Ah, gentlemen, as we study the people of Europe, as we study, the force and the intelligence that they are wasting in a horrible struggle, as we thank God that we are at peace and ask His blessing to every movement for a world wide peace, we come to the study of our own people, and we come to the greatest problem that confronts a country, the development of men and women; and we are made conscious of the fact that there is no greater duty resting upon any individual than to contribute all he can to the mental and moral growth, to the character building of the great body of the men and women of the United States. And believing as I do that the broadest field for the development of our people is found among those who live in rural sections, and believing as I do that the isolation of rural life has been one of the greatest drawbacks to the development, to the furnishing of an opportunity to our people in rural sections, I congratulate you upon your gathering and I wish you God speed in everything that you may do to help make better roads all over our country.

THE CHAIRMAN: I am going to call now on several good roads enthusiasts for short talks. I will call first on Mr. Leonard Tufts, Chairman of the Executive Committee of the American Highway Association.

MR. TUFTS: *Mr. President, Ladies and Gentlemen:* There is a little mix-up on this question, this through road. Mr. Hooper has my deepest sympathy. After talking with him I find that the route he took is not the route Mr. Page was discussing at all. I went over Mr. Hooper's route some three or four years ago; it rained every day I was on the trip and it took me 16 days to cover about 1000 miles and I was stuck in the mud 16 times; not all in one place, but in many places. So Mr. Hooper has my deepest sympathy. The road that Mr. Page spoke of is not entirely improved. As I believe he told you, only some 28 of the 47 counties have been accepted for maintenance, but the improvement in those counties is very remarkable. In one section in northern North Carolina an excellent road was built some 10 years ago and I went over it last year when we were making these arrangements for the office of public roads to look out for maintenance, and there was no visible sign of its ever having been improved. That all has been brought back again into its original shape and is very good now. What the American Highway Association and the office of public roads are interested in in this through road is simply a demonstration to the people of the system of maintenance and in that it is bound to do a tremendous lot of good. Georgia I understand, has not been accepted as a maintenance proposition except in a few counties.

I came down here some 8 or 9 months ago with Mr. Pennybacker to look over the question of holding the Road Convention in Atlanta and I was never more surprised than when I learned of the change in the streets here. Those of you who are not from Atlanta will be interested to know that it was necessary to re-grade certain streets here and in some places to make deep cuts of some 10 feet and I don't know but what it was perhaps more. Only a small portion of the expense was borne by the city. Most of that work was done by the people who had property on those streets. They made no claims for damages; I understand they all signed off before the grades were made, so that there were no damages paid by the city. Many of the buildings had to be re-built and the expenses were great. It is such coöperation as that that you have here in Atlanta that counts, and it is such coöperation as that, that we expect on our roads throughout the State.

We came here to look after space for exhibits. We were told that we could use this street by the side here; we were told that we could use the space under the viaduct. It seemed absurd to me that a city would give up a street in the heart of the city for exhibition purposes, but it was done and it is that sort of coöperation that counts. Thank you.

THE CHAIRMAN: I will next call on Mr. George W. Cooley, State Highway Engineer of Minnesota.

MR. COOLEY: *Mr. Chairman, Ladies and Gentlemen:* I don't know why I should be called upon at this time unless it is to fill up a little space in the program, because I am really not due until Wednesday afternoon at 2 o'clock, according to contract. If I should talk very much now on the subject to which I will allude in my formal address, it would seem like a waste of time. I am going to touch Wednesday on two special points that have already been outlined here by Mr. Page and other speakers. The question preëminently before us now is the question of maintenance. There is no use in constructing a road, no matter how good or what class of material it is made of, unless some provision is made to maintain it and we have the experience of all our western States, or most of them, and the eastern States, especially in maintaining roads, and I expect to hear from them Wednesday afternoon in the consideration of the paper that I will read at that time.

THE CHAIRMAN: Mr. Sidney Suggs, Chairman of the Oklahoma Highway Commission will please come up to the platform.

MR. SUGGS: Mr. Sargeant-at-arms, I wish you would close that door. I am not in the habit of having men leave the hall when I am speaking. I had an audience of 1500 not long ago, and not one of them left the hall during my three hours' talk. Some of them cried. Some of them said "Damn it." Some of them went to sleep, but there was not one of them left the hall; not one. Did I say who it was I was addressing? Why it was the inmates of the Oklahoma Penitentiary on the subject of the Honor System. So you see they could not leave. I am like my friend here who remarked that this was not his time. I want you to be here though when my time comes, because I am going to tell you how it happened in Oklahoma in my native way, just like I would talk it to Oklahoma people. I am going to tell you that you are not religious people, you are infidels if you are not in favor of good roads, you are absolutely—undesirable citizens. That is the idea. I tell them I can prove it by the Bible and I proceed to do it. It has been some time since I read that portion of the Scriptures, but the way I remember it, it says that any man that will not provide for his family is worse than an infidel. Does that mean to buy them something to wear in the shape of 5 cent muslin, cotton goods, or a little something to eat? I say no, if a man undertakes to raise a family and provide for it, it means not only food and clothing but it means schools, books, music, flowers and it means contentment, what God Almighty intended for his children to have in this world and the man that don't provide those things for his family is not a desirable citizen. Now that is the way I talk to them in Oklahoma

and I make them take it. I tell them that if they have anything to say about it, to look me in the eye and say it while I am here. If they want to criticize me, do it while I am present so that I can defend myself. Don't wait until I get off and say "Well that's a lot of hot air." I tell them to do with what we have, we need not wait for an earthquake, we need not wait for another European war—take advantage of this one. I like the machinery man; I like to meet him; I like to see the fire of business in his eye; I like to talk to him about road building machinery. I like to see the man with the material and get acquainted with his methods, but in Oklahoma, provide the ways and means and there will be no dearth of material and machinery. I tell them down there that when Elias was going through the country and met that widow who had to sell her children to pay the funeral expenses of her dead husband, as was the custom of that day and time, he did not ask her what political pull she had, he did not ask her what her bank account was, he asked her what she had in the house. She told him a few jars and a little oil. He told her what to do with what she had, go into the house, go and borrow jars and not be saving, but to borrow all she could, and that is the first time I remember seeing the word borrow in the Bible; but she went and did what Elias told her, and what was the result? She had plenty of oil for her family; enough to pay her debts and enough to live on for some time afterwards, because she did with what she had. We in Oklahoma have got to do with what we have and make the best of it. I like the way Hoke Smith talked; in some respects I was highly entertained, but I want to say to him and to you all that I believe, my friends, we have got to build the main trunk lines before we build the laterals; at least we have got to start the trunk lines, to set the example. I believe it is as much the government's duty to assist in the building of these roads as to build $500,000,000 canals; this money belongs to all the people, and we have been waiting, and waiting for the construction of roads. Whenever they start to build those trunk lines, whenever the government becomes interested in those things, the States will become interested, and when the State becomes interested the counties and the townships become interested and we will build up the system, but if the national government waits for the State, and the State waits for the county and the county waits for the township, it will be a waiting outfit, and I am afraid we will wait until some of us go over the range. I want to see something done.

I am a convention fiend, I go to all of them; if I have not got the money to go, I borrow it, because I like to go to a convention and mix and mingle with men that I believe are trying to do some good for the future of the country. I am glad to be with you; I want to get acquainted with all of you. Sometimes down in my State it seems to me I need more friends than I have; I talk roads until they say it is a habit. I went to a hanging one day—I am a newspaper man, I have been in the newspaper business a long time

and am still running the paper, don't have to do anything but look after the payroll, four boys run the paper—but I was at a hanging and there were 5000 people there to witness it and when the Sheriff brought the prisoner out he said, "We are here 15 minutes ahead of time. There is a great crowd of your friends here; if you want to say anything to them, you have 15 minutes to do it." He said, "Yes, I presume they are all my friends or they would not have come here to see me hung, but I have warned them everywhere I could and I don't know that there is anything more I care to say." Then I jumped up and said, "There are 5000 people here and if the gentlemen will yield the time, I would like to tell them a little about good roads," and I asked the gentleman who was going to be hung if he would yield the time. He said, "Well, I think Mr. Suggs ought to be allowed to talk good roads; I understand that's all he does and I am perfectly willing, but Mr. Sheriff, please hang me first." Now gentlemen, I want to meet all of you.

THE CHAIRMAN: We will now adjourn until 2 o'clock this afternoon, at the same place.

November 9, 2 P.M.

MR. GEORGE DIEHL IN THE CHAIR

THE CHAIRMAN: *Ladies and Gentlemen:* The afternoon session is devoted to the subject of Federal Aid, and is in charge of the American Automobile Association. I was asked to introduce the chairman of the afternoon, and it was not my intention to say anything. But after hearing the speech of the eminent and eloquent Senator from this State, wherein he indicated that he had not exactly in his mind the idea of the work that the American Automobile Association is doing, I think a short statement of what the American Automobile Association stands for in the matter of good roads, and why they now have their principal headquarters in Washington might not be amiss.

The A. A. A. believes in Federal aid in highway construction. The A. A. A. believes that within a year or two at the most the Federal Government will make appropriations to assist in constructing important roads. The A. A. A. believes that should be done for several reasons; first that these roads should be paid for in proportion to the benefit received. The construction of these roads not only benefits the farmer, but the inhabitants of the city, as Senator Smith said this morning; and the reduction in the cost of transportation is not only a benefit to the farmer but to the city resident as well, and it is no more than right that the city should help pay for good roads.

For over a hundred years an effort has been made to maintain roads by the expense being borne solely by the locality, and at the end of the hundred years, the roads were not much better than at

the outset. Then the States of Connecticut, New Jersey, Massachusetts and New York enacted laws providing for State aid, and in some of the larger counties laws were passed providing for county aid. The idea of county aid where a county contained a large city was merely an effort to distribute the cost of construction between the rural and urban localities, and in a county where there was a large city, a fair distribution was often obtained by a county aid law. In other places, however, counties contained no large cities and the cities which benefitted from the construction of those roads did not bear the expense; and so came the adoption of State aid laws.

In the richer Eastern States that contain the large cities this provided for an equitable distribution of expense; but the roads which are constructed in the far Western States and the Central States and the Southern States, which bring the wheat and other products to the railroad, where in turn they are brought to the larger cities, these roads benefit to an equal extent, or to a certain extent, the great cities of New York, Chicago, Philadelphia and Boston, and the only way in which those cities can bear their proportion of expense is by enlarging the unit which is taxed for these roads, and that is one of the arguments for Federal aid in highway construction.

Just to give you a little illustration of the difference in the taxable assets of the various States of the Union—the State of Massachusetts has about 20,000 miles of roads and about $4,000,000,000 of taxable assets; that means $200,000 of taxable assets for every mile of highway. The State of Nevada has only got $700 per mile to tax; they have got one three-hundredths part of the taxing ability to build their roads that the State of Massachusetts has. One-half of the States in the Union have got less than $10,000 per mile; one-half of the States have only a twentieth of the ability of the State of Massachusetts or New York, and it is also on that theory that the government should assist in this burden, as there are many counties in this country which cannot afford to build roads without assistance, and there are also States which need assistance in construction of highways. Therefore, one of the fundamental principles that this Association stands for is that the government should assist in highway construction, also that every political sub-division has a vital duty to perform, and that the township, county, and State each has a duty and that the Federal Government has a duty.

Very often the phrase is used by public speakers and seen in the good roads press, that what we want is good roads from the farm to the railroad station or from the farm to the market, and that we don't want "peacock lanes" across the country for a few motorists; and I am afraid that Senator Smith fell into that error in thinking that the Automobile Association is trying to have roads constructed from ocean to ocean or from the Great Lakes to the Gulf. What we stand for is that the government money should be spent on main market highways and that it should not be spent on lateral or unimportant highways.

The statement has often been made that the construction of roads is a local question, and men oppose county, State, or Federal aid because it is a local question. It is a local question, but it is also a county question, a State question, and a national question. If the farmer starts from his farm with a load of produce for the market, he passes over his own land and the roads on his own land until he reaches a public highway; then he passes over that public highway until he gets to a more important highway, and then passes over that until he reaches a highway which runs through three or four townships and is what might be called a county highway; then he frequently passes over a highway which connects the great centers of population and is a State highway. It must be perfectly evident that the construction and improvement of the road on his own property is purely a personal matter, and that he should keep up the road on his own farm. It is equally apparent that the road which is used only by the people of the township is a purely local question and should be kept up by the township, and that the State and Federal government should not be asked to assist in the construction and maintenance of that road; and that, on the other hand, the county thoroughfare should be cared for by the counties, and that the State should care for the State highways, and that the national government, in turn, should assist in the construction of those roads which necessarily come within the jurisdiction of the national government and are of inter-state importance.

I want to draw your attention to one fact, that this talk of building the road from the farm to the railroad station is something we all agree on; but we believe in starting at the railroad station, because you can readily see the question would arise "A road from what farm?" "Every farm?" Of course, if a road goes from every farm to the railroad station, then every mile of road in the United States will be built; there are 2,000,000 miles of road, and everybody knows that all of the highways cannot be constructed at once. We claim that those roads should be constructed first which carry the greatest volume of the tonnage and accommodate the greatest number of people; that the road should start at the railroad station and work toward the farm, start at the main center of the population and work toward the farm.

The statement is also made that the railroads of the country are the natural highways of the country. It is perfectly true that the railroads do carry and will carry for years the great through traffic; but the local traffic is largely being carried by either electric roads or motor vehicles; in fact in New York State it is not at all uncommon to see delivery wagons 40, 50, and 60 miles from the cities. Consequently we advocate the main roads to be built first, and those are the two fundamental principles that this Association is working for: that the government should aid, and that the government money should be spent only on the main thoroughfares and should not be dissipated by trying to spend it on 2,000,000 miles of road.

We feel confident that real results will be obtained, that the roads the government builds will furnish examples for the various States, and we believe that this work should not of necessity be done by the government, but that the State highway officials, in coöperation with the government, should agree on the roads, the plans, and the specifications, and on the various features of the contract. Then it is only a question of time before those great national roads and the State highways will form the backbone from which will radiate the county roads and the township roads and the whole will be combined into one properly connected and well developed system of highways, which together with the use of motor vehicles, will make for the greatest development this country has ever known.

I did not start to make a speech, but I want to impress these two things on your mind: that the American Automobile Association or the organized motorists of this country are not standing for roads upon which to run a Glidden tour or roads from ocean to ocean, but they do stand for government aid in the construction of highways, and for State, county, and township aid; and we do say that the government money should only be spent on the main roads of this country and that it would be foolish to spend and dissipate it on 2 or 3,000,000 miles of roads.

It is now my pleasure to introduce a gentleman who has been president of the American Automobile Association, is president of the Massachusetts State Automobile Association, and a man who is prominent in the social and business life of the city of Boston and has been well known for years as a sturdy advocate of road construction, Mr. Lewis R. Speare.

Mr. Speare then took the Chair.

THE CHAIRMAN: *Ladies and Gentlemen:* Mr. Diehl informed me that I was only supposed to get up here and say a few words, and give people time to get in here so they could hear the good roads speeches, and the few ideas that I have were covered so admirably that it would sound very foolish for me to attempt to cover them again. As he stated, I come from the State of Massachusetts, where we had the first Highway Commission and the first real organized work on State highways of any State in the Union. We have some good roads, quite a number of them, and when we got down to real work, we built our main highways, and you never find that the Grange or the farmer in our State objects to the policy of the State in building its main highways first. Those highways have been of great benefit to the agricultural work of our Commonwealth. We are not, of course, a large agricultural State, but I heard one member, a lecturer of the Grange on one occasion, give an account of agricultural work in Massachusetts, and he referred to the fact that our State roads had made possible the cultivation of onions throughout the Connecticut valley, to such an extent that the Bermudas had almost been driven out of our markets, and he

gave facts and figures on loads carried over the State roads compared to what had formerly been carried over the old roads. The farmers in the New England States are most enthusiastic over our roads. You must remember that all automobilists do not own high priced cars, but that the great bulk of cars today are those sold at the low prices, and the biggest trade for automobiles is from the farmer—what you might call the farmer interests. This country seems to be divided into about three parts, one-third being real farmers, the second those who call themselves farmers and perhaps are going to farm some day, and the remainder, all those who are looking forward to the time when they can simply farm. All through Massachusetts we had abandoned farms; and, in fact, throughout our New England States we had farm after farm that had been abandoned. Why have they now disappeared from the market? At the present moment you have to pay more for a farm anywhere within fifty miles of Boston than you would if you were to buy an elegant place within eight miles of Boston. The automobile and good roads have brought those farms to the attention of people and they are being occupied and owned as summer homes, and the abandoned farm in the New England States is a thing of the past. You will have to hunt with a fine tooth comb to find any abandoned farms in New England to-day.

I do not propose to take up your time, but I want to emphasize what Mr. Diehl has so admirably covered, that the American Automobile Association is not a pleasure touring organization. The greatest work we have is the Good Roads work and we are working for all the people and for good roads in all parts of our country. We call attention to the fact also that for military purposes this government needs roads. We would be in a sorry plight if we did get into trouble and had no better roads that we have today for moving our troops, etc., and whoever heard of a railroad building its feeders before it built its trunk lines? Now we believe in building the trunk line roads and then building the feeders to their natural sources, and if you get a good road, the farmers who live near that road will take hold, and the whole community will take hold and get a pretty fair road connected with that trunk road, so we do believe that the national government should aid in the building of through inter-state roads, that the States should take hold of the lateral roads, and the counties, cities and towns of the feeders. I have great pleasure in introducing to you at the present time Congressman Borland. He is from Missouri, and therefore he can show us, and I am very glad to have a good audience here to hear him. I have only one request to make, and that is, that on account of the number of ladies who have favored us with their presence today, the gentlemen kindly refrain from smoking.

NATIONAL LEGISLATION FOR GOOD ROADS

By Representative Wm. P. Borland
Of Missouri

The subject of good roads is one upon which city and country are united in a common interest. I have the good fortune to represent a congressional district which contains a city of over a quarter of a million people but which also contains a large and populous rural county. I feel able to speak after considerable personal investigation upon the subject of the absolute identity of interest of the city and country upon this matter. Good roads are beneficial alike to the city and the country. In fact they are vital to the interest of the rural section and of the small town. The city which can depend for transportation upon the great trunk lines of the railroads could very easily get along under present conditions with a purely local system of highways connecting the farm with the nearest railroad station. This system will drain the country of all of its resources, agricultural and financial and will draw to the city like a powerful agent the social and religious life of the small communities.

Those who advocate the system of purely local highways connecting the farm with the nearest railroad station are seeking to perpetuate and strengthen a system which has built up enormous cities by a steady drain of wealth and population from the country districts. Everything in modern industrial life has tended to the aggrandisement of the cities and the destruction of the small town. It would be very easy to build a system of highways under the present enthusiasm for good roads that would have practically the same effect. Such highways would be what are commonly called post roads whose only purpose is to get the produce out of the country district at the earliest possible moment into the big centers. A system of highways can be built however which will do more towards the social, beneficial and industrial upbuilding of the small towns and rural communities than anything else in modern life.

Such a system of highways would open up every section of our country, turn the streams of wealth and population back again to the rural districts, make the small towns again the center of industrial and social activity and check the terrible drain of wealth and population towards the cities.

The time has arrived for coöperation between the State and nation on the subject of road building. I have always been an advocate of federal road legislation because I believe the subject is one of national importance. The rural highway is the first link in the great chain of transportation. Over the rural highway goes annually the food supply of the nation. Every pound of raw material destined for the factories of our land and all of the great export wealth which moves abroad must begin its journey to market over the rural road. No more national subject is before the American

people at this time than that of good roads. It is not sufficient merely to spend money under the attractive title of a road fund. It would be perfectly easy to do this with considerable political success for a few years, but as soon as the people find that they were getting no results for their money a very violent revulsion of feeling would occur which might easily make road legislation a scandal and a reproach. What is needed at this time therefore is not simply to work up an enthusiasm for the expenditure of public money for roads, but to work out a sane and practical system by means of which the roads can be secured at a minimum expense and maintained in passable condition without unreasonable burden on the people. For more than a century we have struggled along under the most clumsy and archaic road system from which a country ever suffered. We have confided the building and maintenance of our public highways to the smallest political sub-division known to our governmental system. This policy of isolated local control was adopted from the English common law at a time when England was a hermit nation with three-fourths of her land in virgin forests which were hiding places for bold bands of outlaws, and at a period in her growth when more than 90 per cent of her educated citizens went to foreign universities for their schooling. We have borrowed that system of local control over the highways born in such an age of English jurisprudence and have retained it long after the mother country has abandoned it. We have tried to adapt it to a great undeveloped country 3000 miles in extent, most of which is removed from the seaboard and even remote from natural water courses. The only wonder is that we have succeeded in developing our country at all under such an expensive and burdensome system. We have expected the little local road district to build and maintain highways without aid in most cases either from the county or the State, and with no aid whatever from the nation, although the duty they were performing was largely a national one and the burden they were assuming was for the direct benefit of the great centers of wealth and commerce. The problem before us now is to equalize the burden of taxation so that the wealth which is drawn from the production of the agricultural regions of the country and centralized in the great cities of the State and nation and in the great export markets of the east, shall be available to carry a portion of the burden of building and maintaing the good roads of the country. The narrow gauge politician will see in this only an attempt to procure money from the public treasury for a particular locality, the broad gauge statesman will see in it the equalization of the burdens of government for the common benefit of the productive forces of the country.

The failure of our present road system is due to many causes, but they are all traceable to the one feature of the isolated local control of the road district. Each little road district is expected to maintain the best highways that it can under the legal powers

which the State chooses to give it, with the taxable wealth that it happens to have at its command and without any scientific or technical knowledge of the subject of road building except what can be picked up by an honest overseer. The result is a patch work of highways on which a large amount of the people's money is spent annually without any permanent improvement. The roads in one road district may be fairly well constructed and maintained because of favorable local conditions. The amount of taxable wealth may be fairly high in proportion to the road mileage: The topography of the country may present few engineering problems: A road material may be easily accessible at reasonable prices. In other road districts upon the same highway the conditions may be adverse. The available amount of taxable wealth may be very small compared with the amount of road mileage to be improved. The topographical conditions may present very serious and expensive engineering problems. The road material may be difficult to obtain within a reasonable distance or at a reasonable price. It frequently happens that the communities which need good roads most are less able to secure them than other communities that need them less. Such a thing as a continuous good road built by purely local efforts is almost an impossibility. It may be said, why do we need a continuous good road. Why will not disjointed fragments of roads do just as well? If roads are looked upon solely as an accessory to the nearest railroad station a few fragments of disjointed sections of roads would do just as well as continuous good roads, but if roads are looked upon as a means of opening up and developing the country, raising land values and improving the social, intellectual and religious life of the rural community, then it is necessary that the roads go somewhere and be connected up into a system of county, State and national highways.

Most nations, have approached the road problem wholly from the point of military necessity. The great highways of antiquity were military roads built to enable the power entrenched in an imperial capital to send its legions speedily against distant provinces for the purpose of either putting down insurrections or collecting tribute. This was the purpose of the great imperial highways of the Romans. In modern life, however, roads are not built for pillage and conquest but for civilization and trade.

Every great nation that has successfully built and maintained a system of highways had found it necessary to classify its highways according to the demands of the traffic. It will be impossible for our country to solve the road problem without some sane classification founded upon common sense. One of the great defects of our system has been to place all rural highways in the same class. If one road happens to be improved better than another it was due entirely to the happy accident of the local situation or local enterprise and not due to any general plan for better means of communication. Modern scientific study shows that under any condition

80 per cent of the traffic will go over 15 per cent of the roads. This is true even in the most primitive conditions and where the roads have no improvements whatever. It is not only unnecessary but it is extremely wasteful to attempt to improve the entire system of highways upon the same basis. It is equally wasteful to attempt to distribute federal money among the highways upon the accidental circumstances of the way in which they happen to be improved at the present time. My county in Missouri has over 300 miles of highly improved rock roads because the taxing power is ample and local conditions are favorable. More than 100 counties in Missouri have not a single mile of rock road and yet the public need for permanent roads in those counties from the standpoint of the productive energies of the nation is just as great. If federal money is distributed wholly upon the basis of the present condition of the roads, those counties that happen to be fortunate in having rock roads at this time will get the bulk of the money while those that are unfortunate and have not been able to secure rock roads will get very little if any. I know of no justification of this system of distribution of the federal money except the Biblical injunction, "Unto him that hath shall be given, and unto him that hath not shall be taken away even what he has." I have always supposed however, that this statement in the Bible applied entirely to spiritual matters and was not a rule of justice as to public taxation.

It will be necessary in my judgment to classify all existing highways into at least three classifications. The first is the great cross State or interstate highways reaching into every county in the State and opening up every section to the benefits of the improved land values, freer social intercourse and higher intellectual life. The second is the main feeders or great country roads, and third, the by-roads, local roads or lands. These various classes of roads should be built, improved and maintained with a view to the amount of traffic that they can bear and must bear. The first class should be of the most permanent and scientific construction. The second class could be of a less expensive nature and would need less maintenance. The third class could be improved only to the extent that the community required. The expense of building and maintaining these roads should be distributed upon the same basis. The roads of the first class should be supported by the taxing power of a large area of country including at least the entire State, because the wealth gathered in the cities ought to contribute to them. The second class of roads should also have a wide taxing power at least coextensive with the county and possibly with a group of counties or with some State aid. This would leave the small road district or local community only the burden of the smaller or purely local roads. However much politicians may twist and turn and argue about the question we must eventually come to some scientific solution of the problem. I realize that when we begin to talk about real road improvement political difficulties of all kinds are encoun-

tered. It is easy enough to shout of good roads and to convey the adroit impression on the minds of every hill farmer that he will have the road pass his place; but when we get down to practical business we will find that only a very limited percentage can ever be improved to a high condition and that these roads must be the ones which will serve the greatest number of people. It is very easy to defeat the whole plan by appeals to the prejudices of those voters who would be led to believe that they will get no direct benefit from the roads. It is possible even to inflame them to high indignation against the people whom they think will be benefited. This is true even though the total expense for a system of roads will not be a cent more than the present expense for a bad system of roads. What the people will demand in the next few years in this country is good roads and no politics.

It is a fatal mistake to mix politics with the good road question. In the legislation enacted by Congress, it is my judgment that provision should be made for a practical and scientific classification of roads, not on the basis of the present accident of their construction but on the basis of their need for future development. It is necessary also that provision be made for the maintenance of roads after they are built. It is useless and expensive to build good roads unless some provision is made to maintain them and roads ought not to be built faster than they can be properly maintained. It will be necessary in the third place to provide for a system of State Highway Commissions which shall be in direct touch with the Office of Good Roads of the Department of Agriculture of the U. S. Government so that the most advanced, scientific and economical methods of road engineering, construction and maintenance may be at the service of all of the roads of the country, even down to the smallest by-road or lane.

I have proposed legislation in Congress embodying those ideas and I am glad to say that these proposals have met with the approval of the real friends of good roads all over the country. I have no pride of opinion as to the details of the plan nor have I any pride of authorship. I am willing that the cause of good roads should be advanced by any method and through any channel that will be of service, but in my judgment it is time for the politician to quit shouting good roads and get down to some practical benefit for the people.

THE CHAIRMAN: Four years ago we had a good roads congress at St. Louis and at that time things did not look as promising as they do today and I certainly congratulate this country on the movement brought forward in such a short time. If it keeps on at the same rate, we certainly will have good roads in this country. At that convention there were a lot of men who came down there to get information. I suppose that is what a great many of you are here for, and when they got up and told us how to build roads that cost

$35,000 a mile, they did not, some of them, seem very much interested, they said, "We have about $35,000 to spend in the State to say nothing of a mile, and we want to know how to build roads without this enormous expenditure." They got down to $6,000, but that did not interest some of them very much. There was a gentleman present at that meeting who had charge of the expenditure of some $50,000,000 in the State of New York, and was doing some great work. He gave us this theory in regard to road maintenance; I can remember very well some points he made four years ago at that meeting. A road commences to deteriorate the day it is opened, and from that day they must commence to repair it. No road should be open to the public until they are ready to repair it; that was his theory. In the light of later events, that same gentleman went to the State of New Hampshire where they perhaps had as many dollars as they had millions to expend in the State of New York and in a conversation I had with the then Governor of New Hampshire, I said, "You have got one of the greatest road makers in the country, but what in the world do you suppose he is going to do up in your State without any money?" "That man has been handling $50,000,000 and it was only a question how fast he could spend it without wasting it, and now he is coming up to New Hampshire and the Lord only knows whether they are going to give him any appropriation next year or not." And as I had to travel over those roads, I was personally interested to see what he would do. I did not know what his theory was. I have not seen him until today since I bade him goodbye in St. Louis, but I have seen his work, and the first thing it seemed to me he did was to repair his State roads which were already in existence and were wearing out or worn out and he did not seem at all in a hurry in building any more roads. What he has accomplished with a small amount of money at his command in New Hampshire is something wonderful, and I believe that information from him as to how he can build such high grade roads with such a small amount of money would be more interesting than how you can build a brick or concrete boulevard at $35,000 a mile. I refer to Mr. S. Percy Hooker, State Superintendent of Highways of New Hampshire, and I take very great pleasure in introducing him.

MR. HOOKER: *Mr. Chairman, Ladies and Gentlemen:* I could not ask a greater compliment than to be credited with the ability to build something out of nothing. I have not been able, however, to get quite that far. There was one point the Congressman made when he said he did not believe there was any man who understood the road situation at all that thought there was any possibility of maintaining a road without building it properly. Well, he picked the one man then, because I do, to a large extent, I think we are going too fast. When I go over the entire United States and see what's got to be done to make passable roads, to make roads that

you can go over, I do not believe that we are following the right line in endeavoring to build all that mileage as we now talk of constructing roads. I don't think it is possible. It does not seem to me it is possible. I went in to New Hampshire with a small contribution and a large road mileage. New Hampshire is largely a tourist State, a State where it was necessary not to have short roads from the farm to the station, but to have roads so that you could travel from the Massachusetts line to the Canadian line and from Vermont across to Maine, and we had hardly any money. With that in my mind I turned around, turned a complete somersault. I made up my mind that it was not possible for us to talk about concrete or brick roads and get anywhere, that our situation was not as much an engineer's proposition as it was a common sense proposition, of getting the worth of our money and maintaining the roads that we should put in condition. Well, of course, there is one thing we had to start with; you have got to start with the drainage of the State road. It does not make any difference if I am going to put on a brick surface at a cost of $22,000 a mile or take the natural sand clay where the surface only comes to $1500 a mile. I build the road in its foundation, in its drainage exactly the same, because that is where my road is going to pieces. With that value, that thought in mind, we constructed, the last three years, the roads in the State of New Hampshire. We find that they are pretty generally satisfactory to the people that go over them. They say, "You have good roads." My average cost is only about a quarter of what it is in the other States, and as I say, my drainage is just as good. My theory is that if you will attend to the drainage, if you will attend to your grades on your roads, it don't make such an awful lot of difference what you put on for your surfacing. I don't see many material men here; they are all in the other part, they will all deny this proposition and say how foolish it is, but when we can build a road at a cost of $150 to $200 a mile, we keep that road through the entire season so it is good enough to drive over, so nobody kicks about the condition of your road, so it will never mire a team or stop an automobile. I think we have a different idea from the ordinary idea, and an idea that a good many of you fellows have to follow out. Now this Road Congress I assume is not for this purpose. I don't know why I was asked to talk today. I have a technical paper on surfacing roads, but I was just asked to get up here and fill the gap because somebody had gone and they knew I was a crank and an enthusiast and would be glad to tell you what I think about the way you have to build roads. Before you can run you have to walk, and when I come down from Washington over the railroad and see the road you now have through this entire section of the country, I don't believe you want brick roads or concrete roads as much as you want more intelligent work in taking care of the drainage and building up the preliminary of your present roads. We are liable to go too far. They come down out of their

pockets in good shape now, in my State, but I have only half a million to spend in half a year; I have between 1100 and 1200 miles of road to keep in condition so you can drive over it at any period of the year without any inconvenience or trouble, and people pat me on the back and say, "How well you are doing." I can take that money and build 20 miles of brick road, but how far would that go? You have got to divide it equitably. It is well enough to say, as the Congressman did, we will take them in order, but you are not going to do it as long as the people in Washington are paying for it. You have got to divide those roads up and the money will be spread out so thin with that class of roads that a lot of you won't see it, it won't get to your county. Now, talking not as a road commissioner but as a Yankee, I believe we have got to spread that money so that the fellows living in the country will see something you are doing and be willing to stand back of you. Perhaps you can point out a road and say, "That is not as good as a concrete or brick road, but you can go clear across the county on it." When a man is starting across the county, if he can go through that county on a road that you can guarantee to him is properly drained, it is pretty good to drive over and he can go clear across the county on it, he will like it a good deal better than to go one-eighth of a mile in this direction at $25,000 a mile, and you won't get many advocates of the building of that sort of a road until you have educated them up to it. My theory is that my road shall be just as good so that the State or county or locality can at any time put on that the surfacing they are able to pay for. You will have the essentials and from that you will educate whatever locality it is, much easier to the proposition of putting on that other surfacing. You will all of you get proud and chesty some day and say, "They have got it over in that other county and we will put on the best surfacing." You will be a great deal more apt to do it if you will get a pretty good road there than if you started very many of the roads I have seen coming down in the country. A man way up in New Hampshire has no business to come down in Georgia and tell you what you can do here. A road proposition is just as much a special feature as a man's suit of clothes is, you have got to cut the road to fit the case, but I am pleading for us meek and lowly ones that cannot go in for the best work and can't build the expensive roads, and yet I want you to feel that you have a future if you will start, if you will take the essentials of this road and build it up, show that you have started and people will back it up to a far greater extent than you dream of now. I don't know why I am here today, I have another paper to take up and had no idea of speaking in any way except to plead for the meek and the lowly—there's a lot of us in the country. Then the Congressman was talking about his Ford car; I go about 40,000 miles a year in a Ford car. They told me I would have Bright's disease if I rode in that car, but I have done pretty well so far and don't see that I have gotten more humps

in my back than I would have if I had ridden in a Pierce-Arrow or a Packard. There are lots of us; there are some plutocrats but they are the favored ones and the rest of us have got to go as we can and I contend it is much easier for me to go around in a Ford car than on my feet; I am sure I would have corns if I had tried to cover 30,000 or 40,000 miles on my feet; and I think in most instances you will find people generally, when you begin the road movement, if I say I guess it will cost us $12,000 or $15,000 a mile you will find lots of people that will have cold feet, but if I show them a road that they can get over, show them a road on which a man can carry as big a bale of cotton or as many bushels of wheat as on the other road and tell them it is not going to cost you any more a year to do it, you will interest them quicker and I believe that in a way we are on the wrong end of the game, we ought to take the fellow where you have not any roads and show him the best you can do for a small sum of money rather than show him the best you can do for a big sum of money. I have just seen a distinguished advocate of brick roads here and I wish he had been in here a minute earlier so I could show him how it figured out. It would cost $700 or $800 a mile interest charges. I think I happened to be one of the first highway commissioners that put in a brick road as a highway proposition, but I don't see how that is going to help a man out in Oklahoma at present. I think you have got to tell him, "Improve your road to the best of your ability with the money you have and you will find a gain in that whether you have the best road or not." I thank you gentlemen.

THE CHAIRMAN: Gentlemen, I have heard from the North and a section of the country where the State finds it necessary to build roads at a low price. The crying need of this country today is how to build roads at a low price. The next gentleman I will call upon is from the South. He has made this road problem a study. I have the pleasure of introducing to you Dr. Joseph Hyde Pratt, State Geologist of North Carolina.

DR. PRATT: This afternoon I feel a little bit like the man who goes to a banquet and just as he is sitting down at the table the toastmaster whispers to him, "I am going to call on you later for a toast." When I have been in that predicament it has very often nearly ruined my appetite for the good things on the table. I am in somewhat the same position this afternoon. When I came onto the platform, Mr. Diehl stated that I would be called upon this afternoon to take part in the discussion of this question of national aid, and I have had to busy myself while these others were talking to make up my mind what I was going to say, instead of enjoying to the fullest extent the splendid things said thus far in regard to national aid and the general question of road work. I was extremely interested in what Mr. Hooker said, although it did not deal di-

rectly with the question of Federal aid, yet it does have a close bearing upon my idea of Federal or national aid. I am very much in favor of national aid, and I do not believe there are very many men in Congress or out of Congress that are not in favor of some form of Federal aid in the construction of roads throughout this country. I have forgotten how many bills have been introduced into Congress in regard to this question of Federal aid. Thus far none of them have been successful in passing both branches of Congress. Some of them have passed one branch and been tabled or defeated in the other, and vice versa. It does indicate that the question of Federal aid is gaining strength day by day, and to my mind it is simply a question of a short time when some Federal aid bill will be passed by Congress. Now I suppose in the discussion it is expected that the speaker will give to a certain extent his ideas as to what he believes is a practical form of Federal or national aid. I wish first to discuss a few ideas that Mr. Hooker brought out that especially appealed to me. First, that the surfacing material of a road shall be dependent upon the traffic that goes over that road. Now you may need in New York State, in certain sections and similarly in Ohio and other States, a concrete or vitrified brick road that costs anywhere from $12,000 to $15,000 or even $18,000 per mile, but do we need it in my State (North Carolina) where the traffic is probably one-tenth or one-twentieth of what it is in those States I have mentioned where they do need an extremely hard surfaced road?

Would it not be much better to put in a surface that is satisfactory to the traffic that is now going over the road and what may be expected in the next five years, so that instead of the road costing $12,000 to $18,000 a mile, it can be put in at a cost of $1500 to $2500 a mile, and yet give perfect satisfaction as regards the traffic that goes over it, *provided* that the original road bed has been so located and drained, that there will never be any question after the highway has been built of re-locating it? They put on any surfacing material you may wish, if your traffic is such that you can put a sand-clay or gravel surface or a top soil surface on at a cost running anywhere in the various counties of North Carolina from $500 to $2500 a mile and satisfy the traffic, is not that the best surface to use? There is no pavement you can put down today, I don't care what it is, that doesn't have to be maintained. It is necessary, right from the minute the pavement is built or the surfacing material put down, to provide a maintenance fund with which to constantly repair the surface of the road. For years with us the sand clay, gravel or top soil surface is going to be perfectly satisfactory as regards the traffic that goes over the road. As the traffic increases it means one thing—that the county is becoming more thickly populated, has greater wealth, and that the road revenue or the amount that will be raised by taxes for road purposes is constantly increasing. As the traffic increases and

finally becomes so great that the present surfacing material is not satisfactory, then you are financially ready and able to put in a harder surfacing material; you have not lost anything; and yet you have had the use of the cheaper surfacing material over a large mileage for a series of years. We have a splendid foundation for any kind of surfacing material, the grading and draining is all finished, and we simply come back and put down the surface the traffic demands. If it is virtified brick, you have one of the very best foundations on which to put your vitrified brick pavement, and it is the same way if we decide to put in some form of bituminous macadam.

We come now to the question of national aid. I believe in national aid; I believe it is a function of the Federal Government to assist us in developing our counties and States. I believe that public roads are public necessities and that it is as much the function of the Federal Government to assist us as it is for the States to assist the counties and townships. I do not believe it is feasible in framing such a bill to say that the Federal Government shall build the same type of road in all parts of the United States, that it shall build a vitrified brick or cement road and that such roads shall be built in every State. North Carolina had much rather, if there is going to be a certain amount of money appropriated with which to build roads in North Carolina, that they locate the road, properly grade it and drain it and then surface it with such materials as will be satisfactory to the traffic that is going over that road in North Carolina. A road does not need the same surfacing in North Carolina as in New York State where you have 1000, 1500 or perhaps 2000 automobiles over each mile of road per day, where in North Carolina we have 100 to 200 automobiles going over each mile of road per day. We get more mileage and get just as satisfactory a road. I don't believe, in connection with Federal appropriations for road work, that they should be used in any way in the question of maintenance of roads built by the State. I believe they should be used in building the main highways, and I further believe that the Federal Government should build these roads and that the States should have nothing to do in regard to their construction; but if the government builds so many miles of road in a State, it should be obligatory on the State to build a certain number of State roads, or roads leading into the highway that the government itself shall build; on the same plan that if you build a State road in most States, it is obligatory on the counties that they build so many miles of county roads leading in to the main State roads. Now the question has been raised that in any Federal appropriation for road construction, it would always be apportioned or tried to be apportioned the same as other appropriations so that each Congressman would be able to get a little for his Congressional District. If you could see road money spent, Federal, State, or county, in the way I think

it ought to be spent, it would create and build up a citizenship of the most unselfish people, because I believe that money for road work should be spent in such a way as to insure the road being built and located where it will serve the best interests of the county, State or nation according as it is a county, State or national highway. I want to illustrate that. I have been advocating in North Carolina State aid. As yet we have not got what we want; but we have got certain State convicts at work on the roads. The first road the State agreed to build was across a portion of Henderson County in Western North Carolina. The extreme northeastern portion of this county is a jog between two other counties, Buncombe and Rutherford, which wished to be connected by a good road. As far as Henderson County was concerned, the building of this road across the jog of the county would be of little or no actual value to the county itself. The township containing this part of the county could not afford to build the road. There was seven miles across Henderson County that was needed to be built to complete a State road from Charlotte to Asheville. I advocated the State's building this seven-mile link, arguing that the county could not afford to build it; that it was a road that the State needs and that the State can't build a mile of road anywhere in North Carolina on a through highway that is not a great benefit to the State as a whole. You cannot build a road anywhere in the United States that is not of some benefit to the United States as a whole. The public roads belong to the people of a State. They belong to the people of the United States; every single man, woman and child has a right to go on any mile of public road that may exist in this country, and if we can ever make up our minds that we will be willing to put into the hands of the Commission, that the Federal Government undoubtedly will appoint, and let them decide where the Federal money shall be spent, I, for one, will be perfectly satisfied that in the end North Carolina will get her part of whatever Federal appropriation may be made; she may not get it this year or next year, but you will in the end see North Carolina getting her proportional part of any Federal appropriation that may be made for Federal roads. In Orange County we carried a bond issue of $250,000 against great opposition, the Road Commission was appointed and the question of location of the roads was left to this Commission. A man in the northern part of the county did his best to defeat the bond issue. It happened that one of the new roads was built right by his farm and he now says: "If there is any talk of an additional bond issue or the county wants to raise any more money to build roads in Orange County, I will go out and work my best to carry that bond issue; a road has gone by my house and I realize what good roads mean and want to see the rest of the people get the benefit of them." If we put the question of where the money shall be spent into the hands of a competent Commission, I believe we can leave it to them and in the end get the best results and we won't have a little piece of

good road here and another piece there and another there and perhaps none of any particular importance as interstate or intercounty roads, and all brought about because some Congressman wanted to bring so much money into his district. I do not believe in Federal appropriations for maintenance of post roads or appropriating so much for each mile of macadam or sand clay or dirt road. I believe in spending Federal money in the construction of roads. In State or county bond issues, I believe that just as much of that money should be spent in connection with the grading and draining of the roads and just as small a percentage as possible in the surfacing of those roads. The grading or location is what you might call the permanent part of the road, and I want to see the Federal money spent on a permanent road, not on patch work to repair a mudhole here or cut down a grade there, but I want to see permanent, main highways located and built through this country. Thank you.

THE CHAIRMAN: It gives me great pleasure to introduce to you a gentleman who, for over 20 years, made an interesting study of this good roads movement, Mr. Clarence Kenyon, President of the Indiana Good Roads Association.

MR. KENYON: *Mr. Chairman and Gentlemen:* I think that you are all interested in this question of national aid. I congratulate you on having listened to not only an eloquent but a convincing argument in favor of national aid by Mr. Borland of Missouri here. It seemed to me that that argument would convince anyone of the necessity and the usefulness of Federal aid in the construction of main, interstate highways. I want to talk a few minutes about the practical side of this proposition. Just to sit here and listen, and generally think about good roads don't produce results. What has been done? What is going to be done, and what are you going to do to help the cause? It's the important thing. Just to listen to an argument, or read a story in a paper, may give you a nice mental reaction, as President Wilson says, but it don't cause you to do anything, it does not make such a conviction in your mind that you get out and hustle for it. I had a queer experience a short time ago. I was going by auto from Chicago to Indianapolis, where I live. A highway superintendent stopped me and said, "I want you to be sure, in going down, to note a certain bit of road." So when I came to that place I was looking at the road which was pretty well furrowed, when I saw a farmer, that classed himself as a hayseed, and thought he was pretty smart, as I found out afterwards, call his boy. I was going very slow and stopped. The little fellow ran out behind the automobile to catch the number and where it was from. Well I saw this operation, although I was part of the time looking at the road. I went in to see him and said, "Why did you send that boy out to catch the number on my machine? Have I been violating the law?" He said, "No; come in. How would

you folks like to have a glass of milk? Johnnie, go and get a pitcher of milk and take it out and give the ladies a glass of milk. I will tell you why that was. Look at that road. I was taxed, and am being taxed for 10 years to come for building that road and it has been down only a little over two years, and look at it." "Well," I said, "what about it?" "Well," he said, "it is nearly worn out already." I says "Well, how can I help it?" He said, "I have been sitting here on my porch day after day counting and looking at the vehicles that go by," and he brought out a little pad of paper where he had been keeping tab on traffic on that road. He says, "Here was yesterday, there were 105 automobiles passed, and not one single one of that 105 had an Indiana mark on it; they were all Illinois, Ohio, New York, or some other State." And he said, "I sent my boy out today, because I could not catch what was on your car, to see where you are from and where you live." I said, "Mine is Indiana and I live in Indianapolis." "But you don't live in my township and my county, you don't pay any part of the cost, and yet you are wearing out the road and tearing it up. I want to know about it." I said, "What is your theory?" "Well," he said, "I don't know of any way of taxing the people over in Illinois and New York, that go through here to Chicago, Cleveland, South Bend, and other places, in troops unless we have the Federal Government pay part of the cost of building these roads that they are wearing out." I said, "I agree with you that far." And he said, "I don't see any reason why you people down in Indianapolis should not help pay, if you come up here and use this road, too. We are willing to pay our share of the cost, but you are asking us now, under the State law, to pay the whole cost, and spread it over ten years, and this road has only been down two years and is nearly worn out now." I said, "That is a splendid argument for Federal and State aid, and I agree with you about it, but what have you done outside of keeping a tab on the traffic and cussing me, and the other fellows, and things generally, because your road is being worn out? Have you said anything to your Congressman about it? Have you gone to him before election and said, 'I want to know what your position on this national aid question is?'" "Well, no I had not thought of that." I said, "that's the reason why Federal aid is not any further along than it is, because you are talking about it, and swearing about it around at the corner grocery, or here on your own porch or out at road conventions, where you get with a few road enthusiasts that agree about it, and you don't go after the fellow that has the say so about it." He said, "Right you are; the first time I see my Congressman I will say a few things to him, by gum." That's what is the matter with us. We get a sort of academic interest in this thing, but we have such a lot of interests of our own that we won't consecrate a little bit of time to push the cause in a place where it is effective, because it is some trouble, and we can't get away from our business, and it is a little out of the

way, and we don't like to write letters, etc. The Congressman might throw them in the waste basket, and so forth and so on. We are not going to get results until the people get an understanding of the question and think it so strongly, that they will go after the man who has got the say so about it. This farmer said to me—"What made you in favor of the government helping to pay for roads?" "Well," I said, "the government builds the Panama Canal costing $400,000,000, many thousands of miles away from here and pays for it out of public funds. It is just a transportation system, and Uncle Sam goes down to Porto Rico and builds miles and miles of roads, and pays for them out of the general treasury and we don't kick at all, we don't shake our fists at the Congressman about that. Then he goes up to Alaska and builds not only miles and miles of highways, but in this last Congress, this Democratic Congress, led by the Democratic President—they have appropriated $35,000,000 for building a railroad, up there, a long way from us, and who is paying for it? We are. You are. You don't kick about it. Congress goes on and does it, and yet, the same amount of money that went to build the Panama Canal, invested in roads in this country, would be of more material benefit to the home people of this country than three Panama Canals. Yet you don't say a word about it. Again we go over to the Philippines and say, "Do you needs roads over here?" "Yes." "Here is the money, we will pay for them." We go out to Hawaii; oh, yes the Federal Government will pay for the roads, but if they need roads in Georgia and Indiana and Ohio and Missouri, oh, no, let the people build their own roads. There is your proposition, and yet you don't put it right in your fist, and go and shake it under the nose of your Congressman and say, "I want you to understand if you are not in favor of a little Federal aid for our highways, I am not in favor of you." When the voters get to doing that, Congress will do something, and then you will get somewhere and not till then. Now, just a word more; Congress has heard, and is trying to do something, but politics must be in it. Along comes one man and introduces a bill in Congress for a $25,000,000 appropriation and he says, "Here, for every mile of post road in your county, that is an earth road over which the mail is carried, we will pay $10 a mile, and pay it to the county or to the township—just hand it out to you, and we will not ask any questions about how it is spent, we will just hand it out. If it is a gravel road, we will give you $15 a mile, and if it is a macadam road, $20 or $25 a mile and this money will go into every Congressional District, every place will get part of it. See what we are doing for the people. We are not going to ask you how it is spent, but you will get it." Now that was one plan, and the House passed that bill by an overwhelming majority. The money was to be spent under no supervision, in no particular place, but just everywhere. Well, when people commenced to think about it a little bit they said, "That's just a pork barrel measure;

when you spread $25,000,000 over 1,200,000 miles of road, what is it going to do? Why, it is such a small amount that it will do no good, and by the time you give it into the hands of 150,000 officials to expend, what would become of it and who is going to make a report about it?" And so a lot of pretty sensible men, as it seemed to me, opposed the bill, and when it got over to the Senate, they had heard from the country, and said no! Now, that is one plan; bear that in mind. The Chairman of the House Committee on Roads is obsessed with the idea that that is the way to do it, that that is going to solve the problem. Come to the next plan. "If the government expends say $25,000,000 and it is apportioned on some fair basis among the States, why the States must expend an equal amount, and the States can raise the money as they choose, by bond issue or otherwise, and that fund will be spent under the direction of a State Highway Department." Well, here's a lot of States that have no Highway Department, and they would not get any of the fund; again there are 19 States that have no power, under their constitution, to issue bonds for that purpose and they would not participate in it. Well, I don't know, that's a pretty tough proposition, where are we at on it? So there was another difficulty, that was urged as a reason why nothing should be done, instead of putting it up to them, and saying "then for God's sake to find a way to do it," the plan as proposed was merely argued down or in abeyance. There is still another plan, that is proposed, namely: that the nation should appropriate a certain amount of money for roads and then have a National Roads Commission and put the money into the hands of that Commission to build, as Dr. Pratt and some others of these gentlemen said, a system of national highways, not all at once, but build them gradually as they are needed, where the traffic goes and where the necessities of the nation require. Is not that practical? If that is not practical, and the other is not and the township plan of sending it out to our rural routes is not, is it not their business as legislators to solve that problem the same as they solved the money question? The way to resume, is to resume. Are they doing anything about really solving it? Not a thing. The good roads people have to go down to Washington every session and urge them to do something. Why? Because the people don't go up to their noses with their fists and say, "If you don't take a little more interest in this road question that affects every man, woman and child in this country, that affects the cost of their living, their social relations, and all that will make this nation better and greater, we are going to do something to you," and then you can bet there will be some response on this road question, and it won't be until then. Some say too, "If we build national roads, they will be nothing but roads for joy riders and automobiles." I will tell you a little experience I had about that. I went up into Marshall County, one of the northern counties of our State, at the request of someone to make a good roads speech, it was in the evening and in a little town between 500 and 1000 inhabit-

ants and I was quite surprised to find 100 or so people there, and I referred to the fact that some people, especially farmers, have a sort of prejudice against automobiles, and I made such argument as I could, that that prejudice ought not to be because it did not make any difference if an automobile did use the road, it did not prevent the farmers from using it, it was just like a railroad, because the King goes over it, or the President goes over it, or someone with a special train goes over it filled with champagne, well dressed ladies, and a lot of jolly fellows, that don't keep the farmer's corn and cotton and potatoes and other things from going over that same road. At any rate, when I got through, there was a farmer with three or four of his neighbors came up and said, "I wanted to talk with you a little about that speech you just made. Your remark about the prejudice that the farmers had against the automobile. Now I will admit we used to have some considerable prejudice against the automobile, but if you would go around a little bit now, you'd find that that is dying out pretty fast." He continued, "I live out in the country, 8 miles from here and these are my neighbors; and I have got a cheap car, and when we heard you were going to make a speech about roads, we thought we would come in and hear you, even though it was cold and the roads were muddy, but let me tell you one thing, Mister, if we had had to drive a team in here to-night, 8 miles and back, to hear you, if you had been the President we would not have come. Farmers have found out the convenience of automobiles just as well as you city fellows and you might just as well get next to that idea, too." I was out in Kansas a short time ago, in Barton County, I said, "How about the automobile prejudice out here?" A fellow says, "Go on; there are 18,000 automobiles here." I said, "What?" He said, "Yes, there are automobiles enough to carry every man, woman and child out of this county in one day. All you need to do is to go to the county fair, and you will see whether or not the farmers have automobiles." That's the idea. Remember that Federal aid can only be obtained, and your State aid obtained by getting next to the legislators, and going after them.

THE CHAIRMAN: Gentlemen, Dr. Pratt has some announcements to make.

DR. PRATT: Mr. Winn has asked me to call your attention to the reception by the Governor at the State Capitol from eight to ten-thirty this evening, and also that delegates desiring to take the trip over the Fulton County roads will please register at the Information Bureau. The Committee has prepared a little folder which gives a description of the itinerary and various points of interest on the route.

THE CHAIRMAN: Gentlemen, the meeting will stand adjourned until ten o'clock tomorrow morning.

November 10, 10 a.m.

PRESIDENT FLETCHER IN THE CHAIR

THE CHAIRMAN: I want to call attention again to the Women's Conference at the Hotel Ansley, at ten o'clock this morning and two this afternoon. All ladies are invited to attend. I also want to call attention to the fact that the annual meeting of the Highway Association will be held on Thursday at 8 p.m. in this room, instead of Friday as announced in the program.

I have the pleasure of announcing the appointment of the following Committee on Resolutions, which will meet at the call of the Chairman.

COMMITTEE ON RESOLUTIONS

Chairman, W. Tom Winn, Commissioner of Fulton County, Georgia.

William R. Roy, State Highway Commissioner of Washington.

George C. Diehl, Chairman, Good Roads Board, American Automobile Association.

Charles J. Bennett, State Highway Commissioner of Connecticut.

H. J. Kuelling, County Engineer of Milwaukee County, Wis.

W. D. Sohier, Chairman, Massachusetts State Highway Commission.

Henry W. Durham, Chief Engineer of Highways, Manhattan, N. Y.

Frank F. Rogers, State Highway Commissioner of Michigan.

C. A. Kenyon, Indianapolis, Ind.

W. S. Gearhart, State Highway Engineer of Kansas.

E. R. Morgan, State Road Engineer of Utah.

James R. Marker, State Highway Commissioner of Ohio.

Major Amos A. Fries, Corps of Engineers U. S. Army.

J. W. Hunter, Deputy Highway Commissioner of Pennsylvania.

Prof. E. J. McCaustland, Dean of Engineering, University of Missouri.

The first matter on the program this morning will be a report by Mr. A. N. Johnson of the Bureau of Municipal Research, New York City.

MR. JOHNSON: *Mr. President, Ladies and Gentlemen:* The Chairman of this Committee, Mr. Wadhams, is unable to be here, so I have been asked to present the report of your Committee on State Legislation.

Your committee on "State Legislation" begs to submit the following report of its work:

It was first necessary that a compilation of all the State road laws should be made. This was seen to be so large a task that unless it was possible to get some assistance the committee could

not undertake it. The matter was therefore taken up with Mr. W. L. Page, Director of the U. S. Office of Public Roads, and the purpose of the work explained to him. He advised the committee that he would have his office undertake the work of compilation, which has been done and is now practically complete. The magnitude of this task can be somewhat appreciated when it is realized that it comprised something over 3,500,000 words.

The laws have been indexed for each State and cross-indexed by subject for all the States combined. But the work so far done will form merely a basis for the real purpose of the work of your committee, which is to formulate a plan upon which the various States would be able to revise their road laws so that there may be a proper foundation for highway work throughout the country.

It is evident that much work will be necessary before such a program can be definitely offered. A chart should be made of the present road laws, by which it would be possible to visualize present conditions. With such a chart at hand, there would then be prepared an outline of the fundamental principles that the road legislation in every State should include.

When such a program has been formulated, it is suggested that the State Legislatures be advised of the committee's work, and that provision should be made whereby it would be possible for the committee to come in direct contact with the legislatures of those States that might request such assistance. Inasmuch as your present committee was appointed by the Third American Road Congress, and as the work is so far from complete, it is suggested that there should be constituted in the place of the present committee, a committee of the American Highway Association to carry on the work as here outlined; and it is further suggested that the American Highway Association provide financial aid that would be necessary for the work. Your committee therefore offers the following resolutions:

WHEREAS: On account of the continuous characte of the work necessary to be done in connection with the compilation and revision of road laws, and

WHEREAS: The American Road Congress is not a continuing body: Therefore BE IT RESOLVED:

First: That the report of the committee on legislation be adopted and the committee discharged;

Second: That the American Highway Association be requested to appoint a standing committee on legislation to continue the work of this committee;

Third: That the American Road Congress expresses its appreciation of the splendid coöperation and value of the assistance rendered by the U. S. Office of Public Roads which has made the work of your committee possible.

Respectfully submitted,

A. N. JOHNSON,
Acting Chairman.

On motion the report of the Committee was adopted, and its recommendations concurred in.

MR. JOHNSON: The committee would further suggest that the chair call upon various members here present to present such views as they have in mind as to what should be embodied in fundamental road legislation.

THE CHAIRMAN: I will first call upon Mr. Henry G. Shirley, of Maryland.

MR. SHIRLEY: This subject is one of the most important before the Congress, in my judgment, and one that should be given close consideration. Your committee has gotten together extracts from all the laws of the different States and if you would put them together, you would have a crazy quilt—they are so different that no one could possibly get up a law that embodies the different phases of all the laws of the different States. I believe it is an impossibility to draw a standard law that will take into consideration all the different conditions that are to be met in each State, but there are cardinal principles in drawing a law which, in my judgment, should be followed in every State in the Union. I think, first, there should be in each State a State Highway Department, a head that can look after the State roads. Then there should be under the same head a State Aid Department; you can govern that as you see fit; then the county laws and the township laws. Now in getting these all compiled, there are certain conditions in each State that will have to be met. Those conditions are restricted to that State, but there are general principles that can be brougnt out and put into a law that can be applied to every State in the Union, and to every highway department. Mr. Chairman, I think that your committee should be continued and should give every assistance possible to the different legislatures and State highway departments which are trying to improve the many laws they have now. There has been brought before the Congress many instances where the laws of a number of States are absolutely inadequate—they do not cover the conditions at all, and will not meet the requirements on account of not being flexible. In drawing a law, I would like to impress upon the members of the committee, and the different legislatures, that the law be general in its terms. There is always a tendency in legislation to restrict or to practically say how to build a road. "The road shall be built so and so, using sand-clay or macadam." That, in my judgment, is absolutely wrong. The law should be made general and leave it to the highway departments to use their discretion. It has become my duty to have to build a road that had been attempted to be built by the legislature absolutely. They said, "You shall use so many oyster shells and put on so much gravel and put it on so thick," and when I got through I did not have a road at all—there was

nothing there. The law that should be drawn up, in my judgment, should be made broad, giving to the State or county commissioner or highway commissioner broad power. Without proper power you cannot do good work; with proper power you can. If it is badly handled, it is not the fault of the law but of the man who carries out the law, and I think it is very necessary that in drawing a law this very important phase of all the highway legislation should be closely studied so as to draw a law that is flexible and broad and gives each department the proper authority.

THE CHAIRMAN: I will next call upon Mr. S. E. Bradt, Secretary of the Illinois State Highway Department.

MR. BRADT: This is rather a short notice to cover a subject of this kind. I concur in what the gentleman who has just spoken has said as to the organization of highway departments in the several States.

The first thing for a State to determine is whether the commission shall consist of one member or more. The advantage of having the authority centered in one man will very often expedite the work. But in States where a large amount of work is being done and in consequence a large amount of money is being expended, a commission consisting of three members will often get better results and give better satisfaction to the public. Also, with a commission of three members there is the opportunity of making their term of office expire in different years so as to avoid the entire change of officials with a change in administration.

Probably the most important factor in connection with a State highway department is the chief State engineer. Practically every decision which he is called upon to make affects in some degree the efficiency in durability of the work. He should be chosen by the commission and should be selected as much upon his record for accomplishment as upon his technical knowledge. His term of office should be during good behavior.

The further organization of the department will naturally depend upon the scope of the law under which the department is working. In a State doing a large amount of work there should be a bureau of roads in charge of a road engineer, a bureau of bridges in charge of a bridge engineer, a laboratory bureau, an accounting bureau and a bureau of statistics. If the work is of sufficient magnitude, the State should be divided into a number of districts with an engineer in charge of each.

The authority given to the State highway department should at least cover all expenditures, both for construction and maintenance, upon the main roads. And if the State should see fit to give to this department the control of all road and bridge moneys expended in the State, it will add greatly to the efficiency and economy of the entire road work of the State. The law under which the department is working should provide the necessary funds with which

to carry on the work either through State or county appropriations, or both.

It will be greatly to the advantage of the State also if the different counties or parishes shall be authorized to issue bonds upon a vote of the people; thus permitting any particular county or parish where the sentiment is favorable to proceed with the construction of roads and bridges as rapidly as the people of the locality shall demand. I consider there is no danger in going too rapidly provided the people are required to vote upon the propostion, and provided further that the bonds for the road improvement shall be issued so as to mature serially and all within the life of the improvement.

THE CHAIRMAN: I will next call on Mr. Charles J. Bennett, of Connecticut.

MR. BENNETT: This is a surprise. In connection with uniform legislation for highway departments, I think there are certain broad, general principles, that can be laid down. I agree with the previous gentleman that these principles are few and are of great importance. The establishment of a highway department, the establishment of town aid and of aid on all roads in the State, is a very good idea. The establishment of a financial principle which will indicate to the people of the State how much is expected from year to year for highway purposes—all these things can be put in a law, but beyond that one cannot go. In almost every case the administration of the highway department is a purely local problem, one that can be solved only by the locality to which it must be applied, so that the law to be formed by a committee on standard legislation must of necessity contain only these cardinal principles and beyond that each State should draw its own conclusions. The main fault that I have to find with all highway laws is this, that they are altogether too long, they contain altogether too much that is not pertinent to the question at hand, and my plea for a uniform State highway law or for any highway law is to give us one that is brief and clear and in simple English without a great many "Whereas's" and "Aforesaid's" and a whole lot of legal verbiage. If the laws of the States are drawn so that the ordinary man can read and understand them and they mean what they say, we will have taken a great step forward. Most of the States have laws which no one can understand. I know that is true in our particular case and it is true in almost every law with which I have had any connection or of which I have made any study, so whoever draws the standard law, for goodness sake make it clear so that we can understand it.

THE CHAIRMAN: Is there anybody else present who would like to be heard on this subject? If not, I will yield the chair at this point to Mr. J. P. Wilson, member of the State highway commission

of Illinois, who will take charge of the meeting during the remainder of the session. Mr. Wilson.

Mr. Wilson takes the chair.

THE CHAIRMAN: *Ladies and Gentlemen:* Mr. W. G. Edens, who is President of the Highway Improvement Association of Illinois, had been selected to preside at this meeting. In the absence of Mr. Edens they have forced me into harness with the distinct understanding that I would not make a speech. It appears that Mr Buck and Mr. Stevens are not present, but their papers will be read and the discussion of Colonel Stevens' paper opened by Mr. J. S. Gillespie, Road Commissioner of Allegheny County, Pa.

EFFICIENCY OF HIGHWAY ORGANIZATION

BY COL. E. A. STEVENS

State Highway Commissioner of New Jersey

The very size and the commercial importance of the highway problem in these United States make efficiency necessary to a fully successful solution. Today we can state the problem in general terms only. Even the total mileage of roads and what portion of them have already been improved are only approximately known facts. There has been but little done in the way of scientific planning of State road work, or of any nation-wide system. Yet, even thus, we can easily foresee an expenditure for roads, that, in its totals, is staggering. There is today no need of arguing the necessity of good roads. The questions to be answered are: Where will the roads to be built be located? What will they cost? How are we to insure that, once built, they will give us the service for which they were built, and for which the people are paying? In all of this how are we to insure that the man who pays the bill is not to be taxed more than need be, that he gets value received for every dollar expended?

It would be a foolish man who would undertake to dig the cellar and lay the foundation for his house without first deciding how much room he needed to house his family; how much he could afford to spend therefor; how he is to meet the cost of housekeeping, repairs, insurance, and taxes; and finally how all this is to be done without waste.

In such a case, it is easy to see the need of some forethought. In the much larger problem of providing good roads for this country of ours, the very immensity of the quantities and costs, and the difficulty of gathering the data necessary to state them with approximate accuracy, or the failure to realize the importance of this knowledge, seems to have prevented preliminary study. With our usual national impatience and confidence in ourselves, we have in general tackled the problem with a view limited to a solution over a very

narrow field. Since we took up the subject twenty years or so ago, the problem of administration, design, and construction, have been changed by motor traffic. This traffic has made the road a matter of general and not of local interest; has shown us that hitherto approved methods of construction are no longer generally available, and that systematically organized methods of caring for our roads and of raising our road funds are at least worthy of our most careful thought.

The road conditions of today in New Jersey and Massachusetts may not show the general problem. They are both old, thickly settled States, and they were pioneers in road improvement. But what road improvement has brought about in those States it will in a like way, if not to the same extent, also bring about elsewhere. In both of these States there is a motor registration of about four vehicles per mile of road, exclusive of city streets. In France this figure is about or a little less than four-tenths.

Evidently European experiences are not to be our final and only guide.

Let us therefore look at our problem for a moment without worrying about what others have done. The best way of doing the job is still an unsettled question. On whom shall we place the burden of arriving at the best method? Taking John Fritz's quip that "an engineer is the man who can do with one dollar what any —— fool can do with two," it is clear that that sort of an engineer is the man we want. Without a force properly drilled in the work, and properly organized to do it, efficiency, the getting for one dollar what with waste will cost us two, is impossible.

With such a force, money and time spent in careful preliminary study, in being sure we are right before we go ahead, will not be wasted. Once when in charge of a machine shop, I hired a new planer hand. Early in the game we had a set of small engine beds to plane. I gave the work, one-half to an old and tried hand, the other to my new man. The special job was new to both of them. The old hand started in to set a bed on his planer without much thought or study, he finished it and set the second in a slightly different way, and had the chips falling from it before my new man did anything but sit still looking at his tool and his castings with his chin in his hands and a look of abstraction on his face. I came near bouncing him then and there, but, on second thought, let him work it out. He had his half done in time to help my old hand out with a few of his castings. That hour or more that looked like a waste of time turned out to be a good investment. We have, and are doing, our work too much in the way of my old and tried man. It is no wonder that roads designed and built without knowledge as to the traffic intensity on them should prove either too weak or more costly than necessary for their purpose. In both cases there is waste.

We need, first, a force that can lay out a well thought out plan with a fair chance to do so without political meddling. The cost

can then be forecast. Changes in traffic may lead to changes in general design and detail as happened at Panama, without making efficiency impossible. The same happens so often with even so simple a task as building a house, that the wise man always allows some margin on the first detailed estimate of cost. With the cost known, plans for raising money can be made for meeting it, and a program of construction arranged with a view of giving the earliest and greatest return for the money spent.

Bond issues and the "pay as you go" plan must be considered. It is evident that over any period for which bonds are issued, the tax levy must include interest and amortization charges on the bonds, as well as the cost of caring for the roads built, and to meet depreciation. If the same amount be raised each year by taxation, and used to meet road building, repair and depreciation charges, it is clear that the amount raised for interest and amortization, and, in the first part of the period, some of the amount raised for repair, etc., can be used for new work. The net result over the whole period is a reduced cost for a given mileage. Against this we have the use of the roads built for a longer average time. This benefit, will, in many cases, be cheap at the increased price, but only on the assumption that bonds are issued on some definite and business-like plan, and the proceeds wisely invested. This has not always been the case.

Any satisfactory road administration must provide for proper design. The data for this is not readily at hand. Traffic figures over an unimproved road bear no relation to the traffic to be expected after improvement. Even were satisfactory traffic data readily available, the economic values of different types of construction are unknown. Motor traffic for not over ten years has been a serious destroyer of road surfaces. It is increasing yearly in intensity. The surfaces specially designed to carry this troublesome and valuable load have not been in use long enough to determine their probable lives and cost of upkeep under the conditions of today. The cost of the road is a yearly one and must include depreciation, if the waste of road material is not made good every year. Therefore, it may well be cheaper to spend money in the repair of a cheap type, such as macadam or gravel, rather than to resurface with an expensive pavement whose life is at the best uncertain.

For example, a macadam road under heavy traffic may be maintained at about the following cost per square yard:

	Cents
Stone, say ½ in. or 42 lbs. @ $3.00 a ton rolled in place	6.3
Bituminous binder, say ⅜ gal. @ 15 cents, spread and covered	5.6
Ditches and drains, say	1.0
	12.9

If an improved type of surface is laid on the old macadam at a cost of say $1.25 a yard, the annual charge to be seen in the tax levy will for some years be merely the cost of ditch and drain work and a small amount to care for imperfections. The community

might, however, have used the $1.25 for new work, or might have left it with the taxpayer; in either case, it is costing the interest which at 4 per cent is 5 cents. We have then a saving of 6.9 cents, but it seems fair to assume that over a life of from 10 to 20 years we should allow at least 0.9 cent for repairs. Our saving is then 6 cents. We would have to realize this saving for about 21 years to get back our $1.25 and if the new surface lasts less than that period it may well prove wasteful.

But any such figures are of academic interest only, unless we have the organized repair force needed to keep our roads in repair and a system of accounting that will give accurate data and that is based on an outlook over a period somewhat longer than that covered by next year's tax bill. On the basis of such a system and with such a force are our railroads operated. Their problem is of the same kind as ours—a matter of cheap and efficient transportation. It is perhaps curious that while the tendency of the day is to regulate these and other public service corporations as to the safety and adequacy of their service, and as to their methods of financing, the people of this country have in no case insisted on such safeguards as to the work of those entrusted with their roads.

The engineering problems of railroading have been solved in their broad lines. We will probably be able, as in the past, to keep on increasing axle loads and reducing ton mile costs, but along lines indicated by carefully collected and thoroughly digested data of many years' work. This, as in the past, will be done by thoroughly trained and competent men knowing their business and eagerly looking for ways and means of getting better results.

With our highways problem we are now searching for the best solution. We have, generally speaking, inadequate and untrained or only partially trained forces. We have no accepted traffic unit and no generally recognized system of accounting. These must be supplied if we are to solve our problem as it should be solved.

MR. GILLESPIE: I heartily agree with Colonel Stevens. He has brought out many good points which we must all admit we have been prone to consider too lightly. It is only by careful and thorough consideration that matters of a constructive nature can be materialized. To get efficiency in road construction it is necessary that definite data be secured along the lines of location, type of travel and type of surface. The engineer should not base his figures upon the travel on the old road, but upon the increased travel that will be diverted to the new road. As he states, sufficient attention was not given to these important features when our first roads were constructed or we would not be worrying about the type of surface for the present day travel.

The travel of today was not anticipated 15 or 20 years ago. The heavy trucks have displaced the ordinary horse drawn vehicles, and truck manufacturers seem to be inspired with the idea of "How

big a load can we possibly haul and still maintain touring car speed." This, then brings out the question, are the roads we are now constructing ample for future wear and tear.

The question of efficiency is right. It must be solved and every corporation in existence is endeavoring to reach the highest possible point. To get engineers of ability to place in charge of road construction, is one of the important features. The question of salary, ofttimes, is a drawback. When you get a good man on road work, pay him as much salary as any corporation would be willing to give him.

The road building proposition is an enormous one. People from our boroughs and cities are moving out to the suburbs, purchasing small farms, and travelling back and forth to their places of employment. The steam and electric roads, we admit, will care for a good part of this continual increasing travel, but there are those who have automobiles and must have some type of an improved road which will permit of travel the whole twelve months of the year. The establishment of well considered routes, along the lines of serving the majority of the people, and constructed to stand the wear and tear of a constantly changing mode of travel, is what is required.

The question of financing road improvements, is one that must be considered by the community in which the improvement takes place. The bond issue and the tax levy plan both have their advocates. I, personally, favor the bond issue, for what is considered the most durable or permanent type of surface. Posterity, in my opinion, will not be saddled with an unjust debt. Safe and sane construction and systematic maintenance will insure posterity of a road commensurate with its value.

The question of purchases is one that must be along systematic lines. Carefully prepared specifications, competitive bidding and rigid inspection should be the motto. Once a road is constructed, much can be wasted in the maintenance thereof by inconsistent or lax methods in the purchasing end.

The unit cost system is being advocated more and more. It is therefore necessary that the purchasing of supplies be systematic, properly maintained records, so as to furnish accurate data for the unit cost scheme.

In whole, the road construction game is a serious proposition, and needs to be based along the most simple and best business principles, and, to accomplish this, it will require well considered plans as to location, carefully prepared specifications and rigid inspection, and above all, personal supervision at all times.

SIMPLIFIED SYSTEM OF TOWN HIGHWAY ACCOUNTS

By Fred Buck

Assistant Deputy Commissioner, New York State Highway Department

In conducting the work of any town highway system which is organized as a distinct branch of a state system the fact must be constantly borne in mind that, in order to secure the best results possible, simplicity must be the watchword. The comparatively great volume of mileage, the extremely small average amounts available per mile and the agencies through which these amounts must be expended all demand a close adherence to plain and simple methods in all stages of the work, and fully as much in the accounting as in any other branch.

By adopting a system of town highway accounts which can be easily followed by the local officials in charge of the work, two important results are accomplished: First, a complete and accurate accounting of funds expended is secured, and, second, the lessons of order and system learned in this are carried, perhaps in the majority of instances unconsciously, to other parts of the work and a more orderly and systematic management of the whole is secured thereby. Careful and systematic methods in one part of any enterprise will induce the same effort in other portions just as surely as lax and inefficient methods, if allowed to obtain a foothold, will spread from one section to another and gradually seriously impair or destroy the efficiency of the whole.

The system of town highway accounts which went into effect January 1, 1909, as a part of the present highway law of New York State has proven very satisfactory, and excellent results have been obtained under it. In order to clearly understand the workings of this system it must be remembered that the funds for town highway work in New York State are derived from two sources: First, a tax levied by local officials upon the several towns, this tax being supplemented by moneys paid by the State to the towns for the same purpose, which moneys are known as "State aid," the amount payable to each town being dependent upon the assessed valuation per mile of highways of the town and the amount raised by the town as the highway tax in each year. These moneys combined form what is known as the highway fund.

In the prosecution of the work the town superintendent of highways is the man in charge. He hires the men and teams, purchases materials, directs the work and acts as paymaster; the paying, however, being done by means of vouchers issued by himself as town superintendent, the vouchers being redeemed in cash by the supervisor (who is the chief fiscal officer of the town) and retained by him as a receipt for money paid until the close of the fiscal year, when, upon rendition of his annual report and its acceptance by the town board, these vouchers are filed with the town clerk and become a part of the

permanent records of the town. These vouchers, which are furnished to all towns by the State Highway Department, consist of a printed form with the necessary blank space for the insertion of the date, the name of the payee, the dates on which service was rendered, the number of hours of service or quantity of material, as the case may be, and the road for which it was furnished. Each voucher is attached to a stub upon which are blank spaces similar to that of the voucher.

The supervisor is provided with a supervisor's account book, printed and ruled to receive an entry of each voucher paid, spaces being provided for data relative to the voucher corresponding to that in the body of the voucher itself. Pages are provided at regular intervals for a recapitulated statement of vouchers paid, the data upon these recapitulated pages being finally carried forward to a single page thereon condensed into a form of statement, which is the annual report of receipts and disbursements required of each town supervisor under the highway law. Blank forms are provided for such additional copies of this report as are required to be furnished to the county superintendent of highways, the State highway commission and the State comptroller.

No other books nor accounts are necessary for the town superintendent of highways or the supervisor in properly receiving, disbursing and accounting for the highway moneys of any town those which have just been described. With practically no exceptions the town officials are pleased with the form of accounting, and errors and mistakes have been reduced to a minimum so small as to be almost a negligible quantity. Partial audits of the highway accounts of any town are made by a representative of the State highway department at any time during the year when for any reason it shall be deemed that the same is necessary or expedient. By doing this many errors are prevented which might otherwise occur and unwise or extravagant expenditures are prevented, or checked if begun.

Each year a complete audit of the highway accounts of each town in the State is also made, and it is found that the form of voucher and manner of accounting for the same provided for the supervisor greatly simplify and facilitate the work of the auditor.

It is pleasing to be able to state that, while the audits of the first year in which this system was put in operation showed a large amount of errors and discrepancies (due, mainly, to unfamiliarity with the system or to carelessness in making entries) the audits of the years since the first show a constantly decreasing number of inaccuracies. It is also pleasing to be able to state that extremely few instances of actual dishonesty have ever been uncovered and that in very nearly all cases in which reimbursement has been required the occasion for the same was due to ignorance or carelessness and not to actual dishonesty on the part of any town official.

Those who have been most closely associated with the work are also firm in the belief that the quality of the town highway work of the State as a whole and the very excellent results secured have

been contributed to in no small degree by the simplified system of town highway accounting which has been used in connection with the work.

THE CHAIRMAN: We will now pass to the subject of road economics by Mr. J. E. Pennybacker, Chief of Road Economics, U. S. Office of Public Roads.

MR. PENNYBACKER: *Mr. Chairman, Ladies and Gentlemen:* They say that when a man begins to read a paper, he can feel the psychic effect of the audience pulling away from him, and if he looks up from his paper sufficiently he will see them staring at the flags and corners of the room and gradually slipping out. Unfortunately the subject of road economics is one so vaguely understood and so capable of misinterpretation that it is very difficult to give it in a general address with anything like the exactness which the subject deserves. With your kind indulgence therefore I will read the paper—as it is very short—in which I have endeavored to lay down those basic principles of economics which I believe should be the foundation of any scheme for road improvement, whether it be on the part of the State, on the part of the county, or on the part of the municipality. It is undoubtedly true the conditions vary so much in different parts of the country that specific measures to meet conditions must be framed, but running through it all there are these certain fundamental considerations which no county or State can go amiss by observing. I will therefore start out by telling you what I understand road economics to be and then I will lay down the propositions which I consider basic.

ROAD ECONOMICS

BY J. E. PENNYBACKER

Chief of Road Economics, U. S. Office of Public Roads

Road economics may be defined as that branch of economic science which treats of the cost and use of a road as a public utility. Cost and public utility, in a comprehensive interpretation, are the determining factors with reference to the amount of money to be expended, the method of its procurement, the liquidation of any indebtedness incurred in connection therewith, the location of the improvement, the character of the work, economy in the management of the project, and the utilization of the completed road for the economic benefit of the public.

The subject is logically comprised in two divisions, the first of which deals with those larger questions of legislation, finance, organization, road classification or selection, the utilization of collateral agencies, and the management of the road as a completed project.

The second division of the subject although more limited in scope than the first division is important from the standpoint of economy and efficiency, as it relates to the various activities in connection with the actual work of construction. Examples under this division would be the lowering of cost by the intelligent use of labor-saving machinery; the keeping of adequate and efficient cost records so as to detect extravagance, incompetence or dishonesty; the systematic purchase of materials, and the use of such other measures as would serve to produce a satisfactory road at the lowest practicable outlay.

Legislation, to be effective, must be economically sound, and it is necessary to the intelligent framing of road laws that the economic considerations applicable to the subject should be known and accepted by the legislators. A system of financing road improvement is largely the outcome of legislation, but is often modified by the exercise of administrative discretion. Organization, like finance, is to a great extent prescribed by statute, but here again the personal equation enters largely in the determination of efficiency or inefficiency. The utilization of collateral facilities of the State, such as convict labor and the aid of State institutions for investigative and educational work is largely determined by law but here again administrative discretion and the personal equation play an important part. The classification and selection of roads for improvement, although resting upon legislative enactment, are much more largely an administrative question than those to which I have already referred, and the same holds true with reference to the use of the road after completion so as to best serve its purpose as a public utility.

It is thus evident that these basic factors should be correlated and that the undertaking as a whole should conform to those economic considerations which may be regarded as fundamentally sound. I have, therefore, formulated ten fundamental propositions which I hold to be incontrovertible and so self-evident as to be axiomatic. I shall, therefore, first submit these ten axiomatic propositions, and then endeavor to explain to you their practical application.

1. That all who share in the benefits of road improvement should share proportionately in the burdens.
2. That the degree of improvement should be proportionate to the traffic importance of the road improved.
3. That the rate of payment or the rate of accumulation of the sinking fund on any public debt contracted for road improvement should approximately equal the deterioration of the improvement.
4. That road building and maintenance comprise work requiring special qualifications on the part of those who direct it.
5. That responsibilities should be definite as to persons.
6. That continuous employment is more conducive to efficient service than intermittent and temporary employment.
7. That the specialists who direct road work should be appointed

instead of elected; and that they should hold office during efficiency instead of for a fixed term.

8. That no road is wholly permanent and that it requires continuous upkeep, for which financial and supervisory provisions must be made.

9. That cash is a much more satisfactory form of tax than is labor.

10. That all agencies at the disposal of the State, capable of use in works of public improvement, should be so used, rather than in such commercial production as would conflict with private enterprises.

The practical application of these ten axiomatic propositions does not involve intricate or impracticable procedure. Under the first proposition, that burdens and benefits should be shared proportionately, I would call attention to the fact that the country road is no longer a mere local utility. The product of the farm is absolutely essential to the existence of the city population, while, conversely, the product of the city factories finds its way to the most remote country districts. There is an inter-dependence which should carry with it a coöperative sharing of the burdens incident to improving the facilities of transportation between country and city. Legislation should, therefore, be framed so as to provide for city taxation in aid of country road improvement. Automobile owners should individually pay a material portion of the cost of our public roads, and they are already cheerfully doing so in many of the States. Last year the state revenues derived from automobiles amounted to about eight million dollars applicable to roads, out of a total from all sources, State and local, of about two hundred and five million dollars. The exact method of apportioning the road taxes is a detail which can readily be worked out by each individual State.

The second proposition, which calls for the improvement of roads in proportion to their traffic importance, strikes at the very root of our present method of apportioning road improvement. Too often have we seen examples of costly improvements distributed according to the dictates of a few influential citizens or according to some arbitrary arrangement of political units or for sentimental reasons, or through a cheerful, haphazard indifference. It is now generally believed that four-fifths of the traffic of this country is carried on one-fifth of the road mileage. It should be manifest that the most heavily traveled roads should first receive attention and should be improved in the most substantial manner. It is entirely feasible to make an expert study of a county road system and indicate graphically the traffic areas for each important road, much as you would show drainage areas for waterways. The yield and the probable traffic in ton miles for these traffic areas can be readily determined so as to establish with reasonable exactness the amount of outlay which the traffic would justify. The relative cost of such a determination would be almost negligible if incurred as a preliminary to a large outlay for actual construction.

The third proposition, that debts should be liquidated in proportion to the deterioration of the road, is intended to prevent the incurring of a debt which will outlive the utility which it was designed to create. There are two extremes in the controversy which rages over this question of public debt. There is the one faction which either opposes debt in any degree, or contends for an indebtedness of such short term as to make it almost a cash transaction, and asserts that the road is entirely destroyed long before the debt becomes due. The other extreme faction contends for long-term indebtedness, on the theory that as posterity will reap the benefits it should bear the burdens, and that a road well maintained never wears out. As a matter of fact, location, if intelligently made, should be permanent; likewise all reduction of grades. The drainage features, if honestly and efficiently constructed, should be reasonably permanent. The road, except under extraordinary conditions, should, therefore, be considered reasonably permanent as to these features. As a general rule, the foundation of a road should not require renewal if the road is subjected to adequate and continuous maintenance. Avoiding any detailed consideration of the exact proportion of the total cost of a road represented by these features, I should say that in general the permanent features would average at least 50 per cent of the total cost. So that, if the other 50 per cent must be figured as perishable and subject to renewal, the debt should not cover a period longer than twice the length of this perishable portion. For example, if a macadam road is constructed at a cost of $6,000 per mile and has an estimated life of ten years, the bonds could run twenty years, because, at the end of ten years the depreciation is $3,000 and the actual value is $3000. Another expenditure of $3000 is made and at the end of the twenty years when the bonds become due, there has been a total outlay of $9000, against which should be credited the permanent value of the road at $3000, making the net outlay $6000, or the face amount of the bonds. This is merely an example and a generalization. It would be desirable to ascertain the permanent and perishable portions in each undertaking.

The fourth proposition, which calls for the employment of specialists in road work, is so nearly self-evident in its application as to require very little explanation. I should say, however, that if the laws of the State would require that all persons selected to have immediate direction of road or bridge construction and maintenance must possess practical knowledge and experience, and if this fitness should be tested by some sort of competitive examination to be prescribed by a State highway department, acting either directly or through a civil service commission, the net result would undoubtedly be the saving of many millions of dollars of road revenue and a wonderfully increased efficiency in our road system.

The fifth proposition, that responsibilities should be definite as to persons, is aimed at the elimination of our present complex and

cumbersome system of road management. If all of this antiquated organization could be swept aside and in its stead one or a few officials endowed with authority and charged with responsibility in each county, the beneficial effects could not fail to be most marked. If the people, individually or in a representative capacity, could immediately place their finger, so to speak, upon the man responsible for the discharge of public duties we should have no more political juggling and the passing of responsibilities and duties onward in an endless chain.

The sixth proposition, that continuous employment is more conducive to efficiency than temporary employment, finds its an ithesis in our present annual or semi-annual junket which we call "working the roads." It is so self-evident that a minor defect in a road can be repaired at its inception with little effort, and that if allowed to go on it may require the entire reconstruction of the road surface, that it seems scarcely necessary to urge the soundness of this proposition. If a small force of laborers with necessary tools and teams were employed throughout the year on the roads it would not cost any more money than to call out a small-sized army of road hands twice a year, and would not only result in quick repairs where needed but would also insure that the most work would be done at the places where it was most needed. The force would be small, mobile, trained, interested, subject to effective discipline and altogether infinitely more efficient than the unwieldly forces now employed.

The seventh proposition, which calls for appointment rather than election and for the holding of office during efficiency instead of for fixed terms, is designed to attract to the work men who look upon road-building as a life profession or occupation. A good engineer may be a very poor politician and a good politician may be a very poor engineer, but in a contest in which votes are essential the good politician will usually defeat the good engineer, although the position requires engineering ability rather than political ability. Do not spoil a good highway engineer or superintendent by making him cater to the popular fancy. If he is the right man in the right place, it is absurd to limit him to a fixed term, for his position is not a reward. The county is purchasing his services and is supposed to get value received, and it should continue to purchase so long as he delivers the goods.

The eighth proposition, that no road is wholly permanent and that it requires continuous upkeep, is intended to impress upon legislators and administrative officials the necessity for making adequate financial provision to care for roads, no matter how costly or efficient their construction. A house is not permanent without repair, a railroad track is not permanent without repair, then why should public funds in a large amount be expended in road construction which, without adequate maintenance, may deteriorate to the extent of 50 per cent in a few years. It would seem almost a reflection upon your intelligence that I should urge upon you these conclusions which

re so generally understood and accepted, were it not for the fact that heir acceptance is very largely in theory and not in actual practice.

The ninth proposition, that cash is a much more satisfactory form f tax than labor, is put forward as a protest against the continued herishing that old heirloom known as "statute labor." If A owes B 10 and B has the option of collecting that $10 in cash or taking the mount out in labor which A shall select and which is totally unfa- miliar with the character of work which B requires and which would be emi-independent of any control by B, we should consider it very nsound business judgment if B were to accept the payment in labor nstead of cash. If you provide an efficient highway engineer or ounty superintendent with a modest amount of cash and let him elect competent, efficient laborers, he can quadruple the effective esults obtained by the same number of laborers under the old statute ystem. I know that there are sections of country where it is almost mpossible to collect a cash tax. A certain amount of discretion might n such cases be entrusted to the county authorities to accept pay- ment in labor.

The tenth proposition, that state agencies which may be used in orks of public improvement should be so used instead of in com- ercial undertakings, is directed partially toward the convict labor uestion, and is based upon the assumption that offenders against ciety owe a debt to society which should be paid in such form as ill most benefit society, and the further assumption that honest labor ould not be discriminated against through the sale or disposal of oducts created by criminal labor. The practical application of is proposition would mean the employment of convicts in road- uilding, the preparation of road materials, or in other works of public mprovement so far as practicable. This proposition is intended so to emphasize the necessity for correlation of the States' various encies in the interest of road improvement. For example, a State ologist should be helpful in the selection and location of road mate- ials, the laboratories of state universities should be useful in the sting of materials, the university staff should be helpful in the ving of theoretical instruction and in many cases in practical exten- on work, state bureaus of statistics and agriculture should be lpful in accumulating essential data for the road improvement work the State, and state civil service commissions should be of very eat use in the inauguration and conduct of the merit system in the ling of positions requiring technical or practical qualifications and perience.

The subject of road economics is entirely too far reaching to be lequately treated in one paper, and I consider it more advisable present to you these fundamental considerations than to attempt hurried and general treatment of the whole subject. You can adily see that under the first division of the subject as I have out- ed it, there yet remains a great field for analysis and discussion

in the detailed application of systems of finance and taxation and in the organization and working policies of highway departments for state and local work. These, I trust, may be dealt with in due time by others, although I may say that it is my purpose to pursue the subject further as one of the projects of my division in the United States Office of Public Roads.

The second division of the subject to which I referred briefly in the opening paragraphs of my paper and which relates to the efficient and economical management of the actual work of construction is important enough for a separate paper. I have pointed out a few examples to show you what this division of the subject comprises, but it is manifestly impossible for me, in the space allotted, to take up the second division even in a general way. The time is fast coming, however, when only those contractors and those officials and engineers in charge of force account work who devote attention to the economics of actual construction can obtain material success.

THE CHAIRMAN: There will be a meeting of the Executive Committee of the American Road Congress, at 3 p.m. Wednesday, tomorrow, in room 326 Georgian Terrace Hotel. The purpose of this meeting is to give hearings to delegates from cities desiring next year's Congress, and the committee requests that all those who are interested in this meeting will please be present. Next will be a paper entitled Educational Field for Highway Departments, by Dr. Joseph Hyde Pratt, State Geologist of North Carolina.

EDUCATIONAL FIELD FOR HIGHWAY DEPARTMENT

BY JOSEPH HYDE PRATT

State Geologist and Highway Engineer

There is undoubtedly a wide field of work for all highway departments in an educational line, regardless of the length of time that the highway department may have been in existence or the actual amount of work that it has accomplished. I do not believe that any State highway department has at the present time absolute control of the location, construction and maintenance of all highways within the borders of its State, but, on the contrary, there are, besides the State highways, county and township highways. Over these latter systems, the State highway department would probably have, in most cases, no actual control but would simply act in an advisory capacity. In many States individualism and sectionalism, as opposed to what might be termed a State-wide community spirit, are at the present time a positive detriment to the general advancement of the State. This is particularly true in connection with the public road movement of many of our States. It is exceedingly difficult to get the members of our general assemblies to consider

the road problem as really a State-wide one, and although in many States there have been organized very efficient State highway departments, they have been limited in their power and limited in the roads that they can control.

For these reasons the work of a highway department is sometimes very greatly handicapped, and its efficiency very materially reduced. These conditions can only be remedied by bringing our people into a fuller realization that public road construction is a business proposition and that the best results can only be obtained when their location, construction and maintenance are under the supervision of a competent head. To accomplish this it is necessary that the people be informed of existing conditions, the need for changing these conditions, how it can be accomplished and the benefits that will result to the State.

The educational work that can and should be carried on by highway departments readily divides itself into three groups:

I. Educational work as it relates to the employees of the highway department.

II. As it relates to county and township road officials.

III. As it relates to the people of the State.

I. I believe there is very great need in many highway departments for the engineers connected with them to be in closer touch with each other and the head of the department. It seems to me that at least once a year there should be a general meeting of all the State engineers and superintendents to be held at some suitable and convenient point in the State, where they would have the opportunity of bringing before the meeting problems that have come up in connection with their individual work and upon which they desire information and assistance. General instructions should be given at such meetings by the State highway commissioner or engineer as to the general policy of the department and the character of the work that they wish to accomplish. I believe that by so doing, the efficiency of the work of the department will be increased and the engineers and superintendents themselves will take a more lively and a keener interest in seeing that the work accomplished is of the very highest order and that the part of the organization under their administration is the most efficient.

For such a conference there is no reason why all the engineers connected with the department should not get together, because they can be ordered to attend by the commissioner, and such attendance should be considered as part of their official duties, and all expenses incurred by the engineers should be borne by the highway department. It is not a bad idea to have in attendance at such a conference some engineer of national reputation to address the members.

The State highway department will find that it is necessary to train and educate young men in order to develop a corps of engineers

of sufficient magnitude to carry on the work that is required of the department. A student just out from college, although having received the best training in the highway engineering department, is not a competent highway engineer, but is capable of becoming one. He can work well under more experienced men, but is not in a position to take charge of road work at the beginning of his career, and he cannot develop into a competent highway engineer without working under and coming in contact with more experienced men. The meetings referred to above are of very great importance and benefit to this type of man, and are of very material assistance in training him for the work that will be required of him.

II. The educational field of the highway department, in connection with county and township road officials, will have to be coöperative. As the State highway department has absolute control only over State roads, and as the county and township road commissions have control over the balance of the roads, there is very great need in many instances for a highway department to carry on educational work in the counties and townships.

In the first place, the highway department must be able to show that they have something to give to the county that is better than the county has in connection with its road work. First of all, they must bring the county and road commissioners to a realization that it is just as necessary that they have a competent engineer in charge of their county road work as it is for the State in State work, and if the State roads have been built in a creditable manner, there is not much difficulty in demonstrating this point to the county officials. It is harder, however, to convince the county and township officials that it is necessary to have men trained in road construction to act as superintendents of their roads. It is in the appointment of superintendents and foremen that politics has played too great a part in road work, and to the detriment of the resulting road. These men should be absolutely under the control of the highway engineer, and, as stated above, should be men who are familiar with and trained in road work.

These men need to keep up with the advancements made in road construction and maintenance, and in order to keep them abreast of the times, I believe that road institutes should be held in the counties at certain intervals, at which time various subjects relating to road location, construction and maintenance should be taken up and discussed. The county superintendent of roads or county road engineer, if there should be one, should hold these meetings once a month or once in two months, when he will go over with his foremen and supervisors different phases of the road work and give them an opportunity to bring up any questions or problems that have come up during the previous month in regard to their work. The State highway department should have general supervision of these foremen's institutes.

It will be found that such institutes will react very favorably on the foremen, and will cause them to take a much greater interest in their work and make them realize that they are a part of an organization which is building up their county or district. One particular feature that is constantly needing development, and regarding which supervisors and foremen need constant instruction, is in connection with the maintenance of their roads, and at these institutes instruction and directions can be given as to how to repair temporarily serious breaks on bridges, culverts or the surface of the road, so that the road is made passable until the superintendent can be notified and a force of road men detailed to make the permanent repairs.

Those connected with the construction of public roads are like any other set of men, in that if they can be made to have a personal interest in their work, they accomplish more and with better results. I believe this personal interest of the road men is of as great or greater value in connection with building roads as in any other kind of work, inasmuch as the question of the disposal of dirt and rock in grading is so dependent on the road men themselves that they can very often waste a lot of dirt and also a great deal of time unless someone is standing over them constantly directing each individual man's work.

The highway department should supply books of instruction for the superintendent, foremen and supervisors, and if used in connection with the institutes they will very materially increase the value of the institute and the efficiency of the men. I have found that the information which it is desired to convey to the road engineers, superintendents and foremen is perhaps better supplied by short pamphlets on the different subjects than by trying to bring it all under one book. Thus the highway division of which I am director has published a series of Good Roads Circulars for the use of the engineers, superintendents and foremen of North Carolina on the following subjects:

Dirt Roads and Their Maintenance.

Suggestions to Road Officials Concerning the Construction and Drainage of Public Roads.

Construction of the Sand-Clay Road.

Status and Duties of the Road Engineer.

Economics of Convict Labor in Road Construction.

Organization of Road Forces.

The Use of the Abney Hand Level.

Construction of the Split Log Drag.

Culverts and Small Bridges for County Roads.

At least once a year State highway department should call an open meeting in each county, to be held at the office of the county or road commissioners, for the purpose of affording instruction relative to matters pertaining to road and bridge construction and maintenance, and one of the State highway engineers should be detailed to conduct the meeting. Upon receipt of such notice from the State

highway department, the county commissioners shall call such meeting on the date set by the State highway department and shall be present themselves and notify the county engineer, the road officials of each township and the county road superintendent or district road superintendents to be present at such meetings in person. Each of the road officials thus notified to attend shall be paid the regular per diem allowance and expenses in the usual manner for the actual time in attendance at such meeting. If the above is incorporated as part of the official duties of the State highway department, it becomes obligatory upon them to call these meetings and also makes it obligatory upon the county officials to attend.

Once a year there should be held a good roads institute, either in the office of the State highway department or, preferably, at the State university or other State institution, where a course in highway engineering is given. At such an institute, which should be held for at least a week, all county and township engineers and superintendents should be obliged to attend as part of their official duties. The program for the institute should be worked out by the State highway department in coöperation with the State educational institution, if the institute is held at the latter place. It will be found that as these institutes are carried on from year to year, they soon become clearing houses for all road problems of the State in which they are held.

Road officials should be encouraged to subscribe to one or more road magazines. I believe it will be found very efficacious for the counties to subscribe for these magazines and have them sent to their road officials.

III. In some States the educational work that a highway department can carry on in connection with informing the people of the State as to the road situation, is the most important phase of educational work to be done. As we all know, the status and life of a State highway department are dependent upon the people, and such a department can only live and develop as it is able to show to the people that it is efficient and of economic value to the State.

Where we have the three sets of road officials—State, county and township—in charge of different portions of a State's system of roads, there is more or less conflict between the county and township officials and the State officials, and this is apt to engender a feeling of antagonism against the State department. This will always be the case until our people, as a whole, realize that the welfare of the State must come before that of the county; the county before that of the township; the township before that of the community, and the community before that of the individual family. At the present time, in many States we are apt to consider things in reverse order to what I have just mentioned. We cannot afford to develop a county at the expense of the State.

I believe that a State highway department should show to the people of a State the work it is doing, what it has accomplished and what it expects to accomplish. This can be done very effiectively by illustrated lectures to be given at the county seats, and by the publication of reports, giving a description of the work done during the previous year. These should be illustrated, and in this connection it will be found that coöperative work with counties can be very advantageously carried on by illustrating in the reports the best work that has been done in several of the counties, giving in connection with the illustrations cost of the construction work. It will be an incentive for county officials to try to see that they get the best results at the least cost.

In many States, counties and townships have been authorized by the legislature to issue bonds for road construction. In some States the State highwy department has the supervision of the location of the roads which shall be built after the bond issue. In other States the whole control of the expenditure of the bond issues is left to the local authorities. In this case the State highway department could only act in an advisory capacity. They should, however, try in every way to give assistance to the local road officials, not only in the location of the road, but in its method of construction. This will be accomplished largely by educational methods. This can be brought about by consultation of engineers of the State highway department with the local road officials. In giving advice regarding the location, they should explain in detail their reasons for the location made, and show how, in the end, it makes a cheaper and better road. They should assist in the determination of suitable surfacing material and advise the local officials as to the most suitable and economical material available for their use.

Instruction by means of publications and conferences should be given local road officials in regard to bridge and culvert work. Specification blanks can be prepared for distribution amongst the counties on request.

In constructing a system of improved roads in any State, there will probably not be over 50 to 75 per cent of the roads that will have hard surfaces, and the balance will come under the head of dirt roads. In some States 60 per cent of the roads will be dirt roads. For this reason it is a good policy for a State highway department to give serious consideration to the care and upkeep of the dirt road, and they should call the attention of local road officials to this and give them instruction as to the maintenance of such roads. Circulars can be prepared and distributed to advantage amongst the people of a State, describing the system of improved roads and calling attention to the dirt roads leading to them, and how, by a little thought and care, these dirt roads may be kept in hard, good condition the greater portion of the year. I do not believe any of our State highway departments are giving sufficient thought and

consideration to the dirt road, and I am confident that a great deal of good can be accomplished by these departments giving more heed to this kind of road and instructing road officials as to their construction and maintenance.

It is just as necessary that men skilled in road work have supervision of the construction and maintenance of the dirt road as the dirt road. I do not believe it is putting it too strongly to say that one-tenth to one-fifth of the time and labor expended in all our States in public road work is absolutely wasted, and this is practically true of the amount expended in connection with the dirt road. The State highway department should consider it one of their duties to give such instruction as may be necessary to enable the people to save this enormous amount of money that is now being wasted each year.

With the advent of the automobile traffic conditions on the public roads have been very materially changed, and not only is it necessary for the State highway department to make a thorough study of these new traffic conditions and the effect of these new vehicles on the public road, but it is also necessary for the department to give instruction and advice to the users of these vehicles, as to the effect of such traffic on the roads and why it is necessry to legislate in regard to their use. The passage of laws regulating traffic will not be sufficient to control it for a great many years unless the users of the road are educated as to the need of such traffic regulations. Therefore circulars should be prepared and distributed, discussing the speed laws, method of passing vehicles, the rights that the users of vehicles have on the public roads, and the license fees or tax required of all users of the roads. I believe that as we are able to inform our people in regard to the public road, that it belongs to all the people and not to any one class of users, and that the laws and regulations regarding the use of the public roads are passed in order to make the road of greatest service to the greatest number of people, that such regulations can soon be enforced with but little difficulty.

The new traffic conditions have increased the dangers of a traveler on the public road, and I think the highway departments should begin to take up a plan of educational work that has been inaugurated, by the railroads, that is, "Safety first." Pamphlets should be supplied to users of the road, cautioning them in using the road to give first consideration to the safety of other users of the road, and therefore be careful in passing other vehicles and in rounding sharp turns. If all would coöperate and have the public's interest at heart, the accidents that occur on our public roads could be reduced to a minimum. Each year there are an enormous number of accidents at railroad crossings, some of which are due to carelessness of the driver, others to the bad condition of the crossing, and some due to negligence of the railroad. Here again is an opportunity for the State highway departments to do very efficient educational work.

Have warning notices posted at railroad crossings. Have cards for distribution, cautioning all users of the road to take extra precautions in crossing railroad tracks. The greatest good, however, can be accomplished by working out a standard plan of crossing for a railroad, when an overhead or underground crossing is not possible. Do not approach a railroad crossing on a grade of over 4½ per cent, and if possible, for 15 feet each side of the rails themselves have the road level. Then keep the road-bed smooth and hard and the space between the tracks flush with the rail.

In order to carry out this, it will be necessary to obtain the cooperation of the local road officials and the railroads. But as it is right in line with the "safety first" movement of the railroad, little difficulty should be encountered in obtaining their coöperation.

In many States the governors are issuing proclamations for civic days, and usually one of these days in known as Good Roads Day. Here the State highway departments have a splendid opportunity of getting in direct contact with those people that have the welfare of the state at heart. The departments can assist the communities in arranging programs for good roads days and furnishing lectures as far as possible.

One other phase of educational work that is, perhaps, as important as any thus far discussed, is that of constructing a sample of model road in those sections of the State where there are no good roads and the people are not aroused to their need of them and the beneficial results that can be derived from them. The construction of a quarter to a half a mile, or even one or two hundred yards of good road in such a community will often be the means of arousing the community to a realization of what they need, with the result that they soon work out a plan by which they can obtain a system of good roads.

THE CHAIRMAN: The discussion of Dr. Pratt's paper will be opened by our friend from Oklahoma, Col. Sidney Suggs, State Highway Commissioner.

MR. SUGGS: *Mr. President and Delegates:* In opening this discussion, I fully realize its great importance and far reaching effect. It is not my desire to indulge in theories, but will, as briefly as possible, draw a practical application of the subject to the conditions which have had to be met in my State where I am best acquainted with conditions. This subject peculiarly applies to Oklahoma for the reason that my department has been made almost exclusively an educational department. There has never been as much as one dollar appropriated for the use of the department notwithstanding the creation of the department was provided for in the constitution in a clause which reads, "The legislature is hereby directed to create a department of highways."

I was president of the Indian Territory Good Roads Association

while W. R. Goit was president of the Oklahoma Good Roads Association. After Statehood, the two associations were consolidated, we began activities with the formation of the new State, a legislative committee was appointed to meet with the constitutional committee on highways. The constitutional provision requiring the creation of a department of highways was the result of the work done by the legislative committee. The first and second legislatures gave little or no heed to this constitutional provision, the committee, however, was persistent, and by determined and intelligent effort succeeded in getting the third legislature to vitalize this provision of the constitution.

The vote was close, in fact, State Senator Pat Gouilding who is now serving on the Capitol Building Commission, changed his vote in order to vitalize this provision of the constitution. The State department of highways was created, the bill provided for the appointment of a commissioner of highways by the governor. The law conferred powers upon the department and defined its multiplicity of duties, but it failed to appropriate as much as one dollar for its use. As a means of support a State license fee of $1 was taxed against every automobile in the State, but there was no penalty attached to failure to pay, and the collection of this tax has been expensive and very humiliating to the department.

Notwithstanding this handicap, the department has gone forward with the duties prescribed by the legislature. It has collected much valuable data and has laid out and made a map of over 2,400 miles of State roads, which have been submitted to the legislature, and which have been approved by the president and secretary of the State Good Roads Association, and have been sent to the joint committee of congress.

The department, by diligent and systematic inquiry learned that 3,300 township trustees were spending from road levies and from bond issues from three and a half to four millions of dollars annually, without the assistance or advice of an engineer. This enormous waste may be illustrated by comparing it with the story of the old lady who carried water from the spring to the chicken lot in a pan full of holes—the water all leaked out before she got to the chicken trough. Large sums of money and much energy have been wasted, and we are still in the mud.

The removal of the 3,300 township trustees proved to be a difficult task, inasmuch as a few of these township trustees were backed by what we term in Oklahoma, the wrinkled tin culvert, tin bridge and toy tool grafters who claimed that the highway department was interfering with home industry. The fight for their elimination has, I am proud to say, been fairly successful. Township officials in most of the townships have retired to private life and the rest of them are making arrangements to retire as soon as the taxpayers of their respective counties take a vote upon their elimi-

nation as the law provides. So much for the early road history of Oklahoma, and this brings us up to the present.

I fully agree with Dr. Pratt when he says there is a wide field of useful work for all highway departments along educational lines. In this connection I am pleased to report that in Oklahoma we have taken this proposition to the rural and high school pupils, both boys and girls, and since the 12th of last month we have carried the message to 3,000 pupils, and have organized *Good Road and Civic Clubs* in four counties. On the 16th and 17th of October the high school pupils of Seminole county built the first mile of educational road in the State. So much interest was manifested by the pupils on this occasion in the construction of the road that a scheduled football game was abandoned in order that they might do the work. The construction work was done by the student body, including the paying of the expenses of the engineer, the driving of the grade stakes, and the carrying of the chain and leveling rod. The width of this road is 20 feet from curb to curb, leaving a parkway on either side. The high school girls who have charge of the civic department of the work, assisted the boys in setting out nut and fruit trees along this educational mile of road. In Stevens county there have already been organized 1,500 pupils and plans have been made to build a mile of educational road in each of the three county commissioners' districts. The county school superintendent, Mr. A. L. Morton is taking a lively interest in this work and declares that the pupils of Stevens county, 8,623 in number, will build one mile of educational road in each of the seventy-five school districts in the county. All work is to be done under the direction of a competent engineer, who holds a commission from the department of highways, and at the expense of the organization. This engineer is instructed to make plans, profiles and specifications, giving first the location, width of road, the drainage, the size and location of culverts and bridges, according to the topography of the abutting lands, the plans state how much clearing is to be done, the number of yards of earth or rock to be moved, together with the estimated cost of each mile; tools and material are to be furnished by the commissioners. When preparations are completed, when the material is on the ground for the culverts and small bridges, the delegates regularly elected, dressed in their working clothes, from each school in the county, will come and do the work themselves under the direction of the engineer commissioned by the State Highway Department. Plans will be made for the constant dragging of the road. At the proper season the girls will finish the work by setting out trees along both sides of the highway. Some of our nurserymen have already agreed to furnish trees free of charge in localities where they cannot be gathered from the forest. Our State superintendent of schools has caught the inspiration and will at once embrace the study of scientific road building in all the schools of the State. In my opinion this is a

most important subject, it is one, my friends, that means more to all the people than any other that is before the public for unbiased, conscientious and sincere discussion, and is well worthy of the consideration of the most progressive and brainiest thinkers of the age.

Mr. President and delegates of this convention. I trust that in your wisdom you will take up the *Unit System of Road Owning, Improving and Maintaining*, having for its slogan *Safety, Economy and Permanence*, and to establish State roads which are to be built and maintained by the State with its own resources. Let those resources come from prison labor, automobile tax, pipe line tax, telephone tax, or from any other source of revenue. The State can then, under the Department of Highways, proceed to lay out State roads along the lines of least resistance, avoid springy places, movable sand beds and impassable grades. These roads will naturally pass through counties, and townships, relieving the tax payers of the counties and townships through which they pass of the burden of building and maintaining these roads forever, from the fact that they at once become the property of the State and are one of its most valuable assets. This system would demand the organization of State road districts numbered in the order of their organization.

The suggestion has been made to do away with 7500 road overseers who under our present condition (not worthy to be called a system) are allowed $80 per annum each, or $600,000 each year and to substitute for the present system of warning out all able bodied men and boys to work the road four days in the year or pay $5 in cash, the plan of collecting from each man who is subject to road duty one-half of this amount, $2.50 and place these sums in the hands of the county treasurer with other road funds, to be divided among the county and township road commissioners by some fixed rule. A county road commissioner and a county engineer should be appointed by the commissioners on efficiency alone, requiring them to execute a suitable bond for the faithful performance of their duties, and a proper accounting for every dollar spent on the county roads. All county roads should be designated and marked county lateral roads connecting with other counties and built to the State roads. Township lateral roads are to be built, owned and maintained by township to connect with county roads, all State, county and township roads must harmonize. This system, in my opinion, will solve the road problem in each State, and at the same time be a great incentive to the educational construction and maintenance of all the roads within the State.

I suggest that you appoint a committee composed of highway commissioners and engineers to work out a unit plan along the lines above mentioned and to make report to this congress. The result of this committee's work to be submitted to the different State legislatures.

In Oklahoma there are 50,000 miles of dirt roads that will be good 90 per cent of the time if they are properly drained, graded

and crowned, then kept up with light wooden drags. The rural and high school pupils are also taught the art of building sand-clay and clay-sand roads, realizing that a good foundation must be laid for a hard surface or metal road, we are at least laying this foundation. We have already taken up the safety crossing for railroads, the department has made standard plans that have been carefully gone over and endorsed by the corporation commission and accepted by a number of the railways of the State.

In Oklahoma we are discouraging grade or surface crossings, and asking wherever it is possible, overhead or under-crossings be adopted. *Safety First* is the motto. I also agree heartily with Dr. Pratt in his recommendation that all State and county engineers, together with road commissioners should meet at least once a year for the purpose of comparing notes and working out problems that present themselves in connection with their individual work. This organization should, in my opinion, extend to the States so that all road work could be harmonized. Some may disagree with me when I assert that no standard plans can be established for the building or maintaining of earth roads. This, I contend, is absolutely impossible from the fact that we have so many different kinds of soil to contend with through which the roads pass, so we, in Oklahoma, have decided to make the best we can out of what we have, and we believe that a well drained, well graded and properly crowned road, kept up by the frequent use of the wooden drag, is the best road for the hoof or the wheel, at least, it is much better than a poorly built and poorly drained hard surface road, and is much easier and cheaper to maintain.

With your permission I want to go on record as saying that it requires more brains, more efficient engineering and more patience to build a good dirt road than it does to build almost any kind of a hard surface road. I mean the building of a road that will some time in the future be the substantial and everlasting foundation of a hard surface road. I tell my people in every community that I visit, that some day the government will organize and begin the building, owning and maintaining of a system of highways, and we must be able to turn over to them a good foundation for their road, and urge every community to take great pains with their engineering and construction of every mile they build, no matter whether it be a State, county or township road. Then, if it is ever used for a hard surface road, they will be consoled by the fact that they will have at least the best road that can possibly be built out of the material at hand. One can hardly find a road 5 miles in length, without coming across 100 and possibly 200 feet of road that is always good, no matter what the rainfall is or the traffic along this particular road. Why is this? I have often put this question to road overseers and road commissioners, and then had to answer that it was nature-mixed and nature-drained, now let us intelligently try and imitate nature's work.

Now, as to the automobile proposition, I believe that it is the duty of all automobile manufacturers' associations and all automobile owners to take up automobile legislation. They should be interested more than any other class in the building of good roads, especially as to the conservation and preserving of the roads over which they travel and the duties of the drivers as to the passing of other vehicles, turning sharp corners, in fact, everything pertaining to the life of the automobile and its traffic, and those interested in road building would prove to be great allies in assisting in getting such legislation as will be effective. This is a matter which concerns not only the driver of a 60-horse-power car, but down to the poor fellow who is walking with a stick along the public highways and is liable to be run down even by the most careful driver.

THE CHAIRMAN: Next will be a paper entitled "The Extent to Which Engineering Schools Should Devote Attention to Highway Engineering Instruction," by Prof. E. J. McCaustland, Dean of the School of Engineering, University of Missouri, Columbia, Mo.

THE EXTENT TO WHICH ENGINEERING SCHOOLS SHOULD DEVOTE ATTENTION TO HIGHWAY ENGINEERING INSTRUCTION

BY E. J. MCCAUSTLAND

Dean, School of Engineering, University of Missouri, Columbia, Mo.

The extent to which engineering schools should devote attention to any particular phase of instruction should depend in a great measure upon the recognized importance of that phase of engineering when considered in connection with the economic and social life of the people of the State and nation.

This does not mean an importance measured solely by the amount of public interest at any particular time, for such interest is often aroused in connection with matters which are of only minor importance. It does not mean an importance measured by the opportunities for men to secure remunerative employment, although such reason should not be wholly ignored. Nor does it mean an importance measured by the amount of public moneys expended, for it is a matter of common knowledge that money is at times lavishly poured out for very inconsequential, trivial or temporary purposes. What it does mean, however, is an importance having its roots in those essential matters which function so largely in extending and enlarging the field of human progress, development and ultimate happiness. Such matters are, the extension of education, nurture and development of religious and social life, the promotion of ease and comfort of living, and in a word, everything which helps to advance civilization.

Much has been written and spoken on the relation of good and bad roads to illiteracy and on the restrictions in the way of religious

growth and social development in communities brought about by impassable country roads. These relations and restrictions are so clearly and so generally understood that it is only necessary to mention them in this connection. No one will deny their truth and their overshadowing importance.

Gaged then by this final standard, highway engineering should have recognition in any scheme devoted to the training of civil engineers.

The question of the amount and character of such special recognition depends, of course, upon the fundamental plan of organization of the civil engineering curriculum under consideration.

The foundation work in the mathematical and physical sciences as commonly included in civil engineering courses is admirably adapted to furnish the necessary and sufficient basis for an excellent training in highway engineering. This fundamental science training involves, among other things, specific preparation in the fields of surveying, chemistry, geology, and economics. For the highway engineer there is need of special concentration on all of these subjects in order to enable him to make the application of their underlying principles to the practical problems he will meet in his professional experience. This "special concentration" may be embodied within the limits of a very few credit hours, and every course in civil engineering should make provision for it.

In courses of elementary surveying and in railroad curves, land surveying and railroad location afford the practical problems and furnish the ultimate purpose for the course, so far as such purpose is purely practical. But railway location is highly specialized, and the attention of the student during his study should be called by way of contrast to problems of highway location. Similarity in the problem should be made clear, and contrasts emphasized for further study. Train resistance, compensation of curves, and cross-sections of roadbed for railroads are very different problems from kinds of traffic, ruling grades, sight distances and maximum curvature on highways. Many highway locations have been spoiled by railroad engineers who could not adapt their knowledge to the demands of their problem. It is for the schools to train their men to "sense" their problems before they attempt a solution. This can be done only by "special concentration" as noted above.

In chemistry, the under graduate student in highway engineering should have a very specialized course in organic chemistry, elementary in its nature, but concise in its application with reference to the principal series of hydrocarbons. He should know how to interpret properly, if not himself perform, all the standard tests on bituminous materials and he should be able to judge fairly of the proper field for the use of road oils both for binding material and as dust palliatives.

Bituminous materials are growing in favor and in extent of use every year for roads and pavements and scores of practicing high-

way engineers are entirely ignorant of the characteristics of such materials. They purchase at random, manipulate by trial, and wonder why their roads fall to pieces.

All men being trained as civil engineers should have a general course in geology and for highway engineers this should be followed by a special course dealing with the origin, nature and physical characteristics of soils. Since by far the greater proportion of the roads of the country are now, and for a long period to come will be constructed of earth it is clear that the study of soils must be of prime importance. In most road building the soil is to be compacted to furnish a foundation, and in all road foundations drainage must be accomplished. A knowledge of the nature of the soil therefore must precede any satisfactory design or construction. It is not necessary to allot much time in the curriculum to this subject since a fair knowledge of chemistry, physics and general geology will enable the student to "read it up" with ease, but its importance should be emphasized in the mind of the embryo highway engineer.

A general course in economics is the necessary part of an engineers training and the highway engineer should be made familiar with the subject of trade and transportation as a whole, and with highway transportation as a special field. He should also become familiar with methods of financing highway construction such as bonding, general and special taxation and the like. He should have some knowledge of the laws governing the inauguration of public work, the advertising for bids and the letting of contracts, the guaranteeing of quality and the essence of contracts.

It is of interest and value to the highway engineer, but probably not essential, that he should be familiar with the historical development of the subject of highway construction. If he is to carry weight as an advisor in public matters, the possession of historical perspective could not fail to give emphasis and support to his expressed opinions.

Finally he should have opportunity to make special study of road materials in the laboratory. Sands, cements, mortars, stone for road metal, bituminous materials and all other substances that go into the construction of highways should become more or less familiar to him through actual manipulation.

Now all these various lines of study as above recited, should not require any great amount of time if the student has previously been given a fundamental training in the subjects mentioned. Since practically all the civil engineers in the schools of the country are trained in the elements of surveying, chemistry, geology, economics, history and materials of construction, the additional training needed, as outlined above, can no doubt be included within a total of two or three credit hours for two semesters or four to six credit hours in all. A credit hour means a lecture, recitation or laboratory period per week for the half year. Actual practice in the schools varies very widely throughout the country as shown by the following tabulation.

Table Showing Time Devoted to Highway Engineering Instruction in Various Universities of the United States

NAME OF SCHOOL	LENGTH OF COURSE	TOTAL CREDIT HOURS HIGHWAY ENGINEERING INSTRUCTION	
		Required	Elective
Columbia	5 years	2	16
Cornell	4, 5 and 6 years	1	
Illinois	4 years	2	
Michigan	4 years		3
Minnesota	5 years	3	
Missouri	5 years	2	2
University of Washington	4 years	2	4
Wisconsin	4 years		4
Yale	5 years	2	

THE CHAIRMAN: We will now listen for a few moments to Mr. Phil Mitchell, from Illinois.

MR. MITCHELL: I came down here in connection with my associate Mr. Woodcock, who is Secretary of the Rock Island County Highway Improvement Association, of which I have the honor to be President, to learn something at this meeting. We make no pretense to scientific knowledge of roads. We know that in our county we have very poor roads and we are ambitious to improve them. Rock Island County is comparatively a small county in area, but it is a rich and fertile county with a population of about 75,000. I merely wish to state what we have attempted to accomplish in our community toward getting good roads. We made a vigorous campaign, we visited every township in the county and argued the issue of $1,000,000 worth of bonds for the construction of 131 miles of roads which had been selected and designated by our Board of Supervisors, and nobody as far as I ever heard, objected to the roads that were selected. They were deemed a wise selection. Our object was to provide ways and means of building those roads. When I was elected to the Presidency of this Association, I was appalled by the magnitude of the proposition. I did not see how anything could be accomplished and thought we would simply go as we had been going for the last 50 years, electing incompetent road commissioners or supervisors, one of whom would plow a ditch on one side of the road and turn over a little soil there and then the next commissioner would come along and turn it back again. That is about the way we had been going along in the past. We made an earnest effort in favor of these bonds of a million dollars which were made legal. It was made possible to legally issue them by means of the Tice Law which our good Chairman here, who is a member of the Illinois State Highway Commission and Mr. Bradt, who is also here, can tell you more about than I can. I wish to say in this connection that both these gentlemen and the other

two members of the Illinois Highway Commission gave us most efficient assistance in our campaign, coming to our meetings, not arguing particularly for any special bond issue, because that was out of their province, but giving us information as to the kind of roads we should have and how they could be gotten. I am very sorry to state that we were unable to succeed in our campaign and we feel as though we were stabbed in the back by the efforts of our Board of Supervisors. We have 35 members of the Board in our county, and when we presented this proposition for bond issue before them, after it had been thoroughly discussed and canvassed and published throughout by the papers in every township in the county, we went before them and asked for this million dollar bond issue and they went into secret session and then beat the proposition. Now the only question we wanted was for the Board of Supervisors to agree to leave this proposition to the people, and if it had been beaten at the polls, of course, we would have submitted with good grace. But we did not submit with good grace to the manner in which it was withheld from the ballot. There is no sentence the great Lincoln ever uttered probably that has been quoted oftener than this, "Government of the people, for the people and by the people." That was all we asked in this proposition, that the people should pass sentence on whether we should or should not issue these bonds, and we were deprived of the privilege of voting on that proposition, but our Association is still very much alive, as evidenced by the fact that Mr. Woodcock and myself are both here to seek information along lines leading to the ultimate construction of 131 miles of good roads in Rock Island County. Now the cost to the farmers there was comparatively little. I have a farm and it would have cost me $10.82 a year on the first year for these bonds, which would provide for the issue and retirement of $50,000 of bonds every year and gradually that tax would become less; probably it would not become less in a way because the building of 131 miles of roads in our county would be such an object lesson that the work would be extended and we would get more roads, but that is what we attempted to accomplish.

THE CHAIRMAN: Is there any further discussion? Remember the annual banquet this evening at the Kimball House. You can secure your tickets at the office. This completes the program for the morning session, and we will now take a recess until 2 p.m.

November 10, 2 p.m.

MR. PAGE IN THE CHAIR

THE CHAIRMAN: Gentlemen, in the movement for better roads throughout the United States, we have experienced a great many vicissitudes. One of the greatest drawbacks, in my judgment, which has confronted our work, has been petty politics and a poor selection of the proper man to take the responsible positions. We all

remember a few years ago, when politics throughout the country changed, there were six States in the Union whose change of the political parties brought about almost a complete change, in even the technical positions in the Highway Departments of those States. Men that had had years of experience in engineering work and had learned local conditions and become of real value to the public were thrown out of office simply because of their affiliations with a certain political party. Now in the government service we are absolutely free from politics as far as our road work is concerned, and I think that Mr. Wales, who represents the United States Civil Service here, will tell you that there are few of our engineers who would take the positions they do, at the salaries the government pays, unless they were assured that we were free from politics. We have this afternoon the coöperation of the United States Civil Service Reform League which has done so much to apply the merit system to public service work. There is no branch of public service work where we need the coöperation of the Civil Service Reform League more than in the work of bettering our roads, and it is my great pleasure to introduce Mr. Richard Henry Dana, President of the National Civil Service Reform League, who will preside this afternoon.

Mr. Dana takes the Chair.

THE CHAIRMAN: *Mr. President, fellow citizens and members of the Congress:* The subject of my address this afternoon is how to take the roads out of politics.

HOW TO TAKE THE ROADS OUT OF POLITICS

BY RICHARD HENRY DANA

President, National Civil Service Reform League

The chief motive that impelled civil service reformers to devote their energies to the adoption of the competitive merit system for government appointments was to diminish the power of the political boss by taking out of his hands the unrestricted patronage of appointive office. The so-called "spoils" system was not only injurious to the efficiency of the government but it created an army of political workers, thus building up an enormous political "machine," active in politics all the year round and often opposing the interests and wishes of the people at large. Before such an army of trained, disciplined, well-generaled party workers, paid out of government funds, the ordinary citizen was as helpless as a mob in the face of a regular army.

What about the size of this army? Altogether, counting the federal service and that of all other branches of government—city, county and State—within the United States, the total number of

persons is over 800,000 and the total salary something like $700,000,000 a year. But for civil service reform this would all be an enormous political standing army, and this stupendous annual sum of money would be all used to influence primaries, caucuses, conventions and even elections. Hardly more than one-third of this army and salary is controlled by civil service rules and laws. The rest is in politics.

The improvement of the civil service was at least in the earlier days considered more as a by-product than as the main purpose of the reform. This by-product has become more and more important as we have advanced. It has been proved officially again and again that the government work is far better done by fewer people when under the competitive merit system than before; for example, in the railway mail service, where careful records are kept, since it has been put under the civil service system more work is done per capita at more than three times the accuracy of the best record ever made before, and five times some of the others. It has also been officially computed that the saving in the federal service alone is about $20,000,000 a year.

During the first fifteen years of the merit system it was applied mainly to subordinate positions, such as clerkships, policemen, firemen, bookkeepers and the like, omitting the laborers at one end and the higher officials at the other. We have been very slow in extending the system upward. We have extended it sideways so that now we have civil service laws in 9 States and about 250 municipalities; downward, unskilled laborers in the federal service and some cities are selected on a basis of age and relative physical condition so that the laborers are taken out of politics and the public gets young, active and able bodied men. As to its extension upward, we have made considerable progress as I shall explain more fully further on, but for the present all postmasters with salaries over $1000 a year, all collectors of internal revenue and their deputies, all collectors of the customs and United States marshals, for example, are outside the civil service rules, and the same principle applies in the main to the civil service of those cities and states that have civil service laws. As a result, while we secure better subordinates the head positions, in which the brains ought to be, are usually filled by persons without proper education, training or experience. This is not all. The more capable subordinates finding that promotion to these higher places is shut off from them soon get discouraged and resign from the public service.

Still further, while the boss has been deprived of a large amount of his patronage, he still keeps the best paid offices and, through his power over the heads of city departments and other high officials, is still able to give contracts, jobs, and the furnishing of supplies to political favorites.

It is now one of the objects of the Civil Service Reform League to arouse public opinion so as to compel Congress to allow the higher

postmasters, the collectors, and the like, to be put in the classified civil service, so that such places may be filled by promotion and in general to extend the law upward and thus to take contracts out of politics.

I shall now come to the application of the general principles of the reform to the experts in road construction.

What is the condition of road construction as we see it within the United States? Is there not a great proportion of the work in the control of incompetent persons? Even where good road experts are employed is there not constant interference by their superiors to give contracts as political favors, to enforce too rigidly or not enforce at all the specifications for political reasons, and to do superficial work about election time to deceive the people into thinking that a good job has been done at small cost?

Let me state some of the advantages that come from the employment of experts in road construction. It will save waste from poor plans, poor methods, use of the wrong materials, improper or insufficient sub-drainage, or surface drainage, insufficient foundation, waste in the supervision of labor, loss from insufficient specifications and from failure to enforce good ones properly, the lack of proper super-elevation at curves, causing great wear both on the road-bed and the tires; and the employment of incompetent laborers employed to give influential voters, or friends of active politicians a job at the expense of the public at high pay; and the inability to get a day's work for a day's pay from those otherwise competent men who know that they hold their job not for what they do in road building, but through the political influence of the party boss behind the throne of the road authorities.

The experts, especially the chief experts, hold their office as a rule, do they not, at the pleasure of political superiors or of superiors who themselves, though not active politicians, may be removed for party reasons or are themselves elected officials who look for a re-election which may depend more upon satisfying a political boss or packing a primary than upon securing good roads for the public, and is it not also too often true that the position of the expert is needed to carry out some party plan or complete a factional slate? At all events, the employment is so apt to be temporary and the changes are so often made even when good experts are employed, that continuity of policy is not carried out. Fear of removal and the desire to help those who have given the appointment tends to bring the expert into politics. No permanent career can be offered to younger men who enter from the lower grades of expert work; no hope of promotion to the upper, and as a rule it is hard to get the men of the best ability to leave well-established work with private persons or corporations, for the uncertain and sometimes distasteful work of public employment. It sounds more funny than fiction when we read the truth from this year's report of James W. Osborne, Special Commissioner to investigate the New York State

Highway Department, that the inspectors to pass on contract work were some of them barbers, tailors, prize fighters, bartenders and bakers, and, as might be supposed, that their inspection "was totally inadequate."

But even supposing that the experts from top to bottom are appointed absolutely free from political favoritism of any sort and are men of good ability, their powers are limited. To be sure, some road commission for the time being, here and there, may be found that will not interfere with their experts, but as we have seen again and again, the experts are subject to the direction of the non-expert, political or semi-political boards, or elective officials, and have to submit to the superior authority which can put a joker into a contract; modify the specification; order poor work to be accepted, or good work to be refused on the payment or non-payment of political contributions, or the possession or non-possession of political influence.

As an illustration we have the case of the New York State Road Construction, and nothing was more evident in the investigation than that in many cases the experts were entirely opposed to the action of their superior officers which they had no power to prevent, and it was contrary to official discipline to expose to the public the various methods that were used for giving contracts to influential politicians, or for securing political contributions at the threat of holding up pay for work done.

But someone will say, if we leave road building wholly in the hands of experts with independent tenure of office, we are not having local self-government; we are interfering with the representatives of the people and choking off the expression of public policies. We must admit that if we should make our experts complete despots that there would be a great deal of truth in these objections. Can we not, however, find some line of demarcation between the two extremes? I think we can. The representatives of the people, the policy determining executive or board or legislative body should decide upon the general public policies as to the amount of appropriations, just where good roads are to be built, as for example between which towns and cities, or what general principles of choice are to prevail, but, on the other hand, the powers of the experts should be supreme in the *operative* sphere as distinct from the policy determining. The operative sphere should include the full control of the preparing and awarding contracts and the enforcement of specifications; the control of labor; and the purchase of supplies, and everything else that is necessary for securing the best results at least cost to the community. The community should have a right to say how much they will be taxed and what it is they want done, but beyond that the community will get the best results, will they not, if it will leave to experts, selected without regard to politics and free from the danger of political removal or interference in any way, the carrying out of the details of the plans necessary to accomplish the purposes the public have in mind. The experts too should

be allowed freedom to advise and even educate public opinion as to public policies within their specialties.

We then have to consider the three chief points: first, the selection of experts which will secure from top to bottom experts of ability, experience, and character; second, tenure of office during capacity and good behavior and third, ample powers within the operative sphere. Now for the selection of the experts in any large public service devoted to road building. There should be a system of promotion from among the assistant engineers and other experts that would secure the highest positions when vacancies arise to those who have shown the best ability and achievements, and entrance to these lower positions should be through civil service examinations. Where there is not found among the subordinates anyone suitable for promotion or where the service is new, then it is necessary to go outside. And in such cases there ought to be freedom to select experts from all parts of the country, and an ample inquiry into the sufficiency of education, training, special ability, and the possession of organizing and executive faculty among the candidates. Now how can this be done? The adoption of the Civil Service System would secure promotion but no open competitive examination composed of written questions and answers of the "scholastic" kind would ever be suitable for the appointment of the chief experts in any such undertaking as modern road building on a large scale, but when I have said this it does *not* mean that the experts may not be still selected through civil service methods for the civil service methods are *not confined*, as too many persons take for granted, to the written scholastic examination conducted in the same room and at the same time, such as are used for the selection of clerks, bookkeepers, and the like. Every method known to business for the ascertaining of the relative ability of various candidates that is capable of being systematized, that is, every method excepting that of pure favoritism, can be and is employed by civil service commissions. Bench tests are used for selecting mechanics, physical competition for policemen and firemen; saddling, mounting, riding horses, and firing from horseback have formed part of the civil service examination for United States rangers. For the last fifteen years men of high organizing and executive ability, power to handle subordinates and get on well with men, combined with appropriate scientific knowledge, have been secured for high governmental positions by what is called the "unassembled investigation of careers" conducted by civil service commissions. Though this has been in operation for fifteen years, as I have just said, its existence is still unknown to many experts, statesmen, and I may say to the great majority of our citizens, and it is largely for explaining this method of selection and showing its applicability for the choice of experts in road building that this paper is written. Let me give an illustration.

The office of librarian of the enormous library system of the city of Chicago became vacant. It was found that that position was

classified under the civil service rules. The first idea was that an exception must be made and the appointment authorized at the discretion of the Mayor for the reason, as stated, that it would be impossible to fill the place satisfactorily by any "scholastic" examination. The civil service commission and the civil service reformers of Chicago were well aware of this "unassembled investigation of careers" and how successful it had proved and they undertook to make the selection under the civil service rules. First of all advertisements were sent out over the country and especially to all the journals devoted to library work, and letters were sent to library experts to suggest candidates. It was explained that the examination would not consist of the ordinary sets of questions and answers but that each candidate should reply from his own home or office to a detailed inquiry as to his education, training, and achievements in life. Then three eminent librarians were chosen to aid the civil service commission in this investigation. The three chosen were Mr. Herbert Putnam of the Congressional Library, Washington, D. C., the head of the Crerar Library in Brooklyn, New York, and the librarian of the University of Chicago. These men aided the civil service commission and their chief examiner in drawing up the questions on the experience sheets sent to the various candidates. The candidates were also asked to send in any book, pamphlet, or paper prepared by them on library administration or kindred subjects and to give the names of persons for whom they had worked, who would know of their successful administration. Then, after weeding out those who from their own statements were manifestly unfitted, there were sent to these former employers searching questions which were answered in detail showing any facts tending to prove the possession by the candidate in question of executive and organizing ability, any unusually successful work accomplished, the possession of such temper and manners as would enable the candidate to get on with other people, and the ability to handle subordinates to advantage. Each candidate was also asked to prepare a thesis on the management of the Chicago library system, and to aid him in understanding the situation he was furnished with the latest official reports of Chicago relating to the library and the municipal budget and resources. These theses were prepared at the homes or offices of the candidates and sent to the civil service commission. As a result of all this investigation and the examination of these records by this jury of three great experts, Mr. Laegler was put first. As the civil service records, thus prepared, showed, he had been librarian at the Wisconsin University; had there instituted some methods of library administration of such value that they were being copied by other libraries all over the country; had, when in another capacity, practically organized the splendid university extension work and public aid given by the University of Wisconsin; had gone before committees of the Legislature and explained his methods and secured appropriations; and had been able to train

his subordinates so as to get the best possible results. Indeed, as Mr. Putnam said to me, there was no better man that could be found in the country not lready occupied in some better position. In some of the non-assembled investigations, the candidates are questioned orally by this expert examining board and further graded on personality.

Now let me call your attention to one or two matters. Through this method there was secured what every appointing officer should secure, that is, a thorough investigation into the capacity of all the candidates, but a kind of investigation carried out with a degree of thoroughness that we know is not exercised by appointing officers even when they are free from any political motive and desire to secure the best results, not even by most business men or corporations. Indeed, the art of appointing the best from a large number of persons for responsible positions is, by no means, as simple a one as many people suppose. Again, all the evidence on which the selection is made is a matter of record, so that at any time the grounds of selection may be reviewed; an effective guaranty against favoritism, and the appointment is made without the appointee's being under obligations to any party, party faction, or political boss; and finally when once appointed in this way the tenure of office is practically secure because the motive otherwise existing of removing an expert, namely, to give the appointment to a favorite, has disappeared, for the appointment of a successor must be made in the same way that the original selection was made, or else by promotion from a limited number of persons who have secured their positions by open competition. Then again, when the position is thus put under the civil service system and the tenure of office is secure, instead of keeping able men away, it is found by experience that it has attracted them. It has commonly been said that you can not get able men to enter the civil service examination, but in the words of the United States Civil Service Commission commenting on the results of such civil service investigations in its twenty-ninth report:

> Examinations of this character have been found to attract men of the highest type. A belief in many quarters that no distinguished expert or person of high professional or scientific attainments will compete in a civil service examination is a fallacy.

This has also been the experience of municipal and State civil service commissions that have tried the system.

At a hearing of the Legislature in Massachusetts on a bill to allow heads of departments to be selected in this manner, Professors Swaine and Sedgewick of the Massachusetts Institute of Technology said that they usually advise their graduates not to accept public work, because it is so mixed with politics, but should these positions be put under the civil service system and carried out in the way above explained, they, on the contrary, would urge all their graduates to enter this kind of public service.

Another objection has been made that there are not sufficient experts in the country to fill all the positions in the road construction that is going on. However that may be, we can secure all the experts there are who are willing to undertake the work, and if one will just read the catalogs of the leading universities of the country, he will see that more and more time is given to the education of experts in all kinds of municipal and State undertakings, among which road building is one of the most commonly taught. The supply of young men who can be put in the lower grades of expert work and make their way up, through promotion, is very great.

Some objection is raised, on what is really *a priori* and theoretical grounds, that experts with tenure during good behavior and capacity, would not accept new policies. In practical operation, exactly the opposite is found to be the case. Not only do such experts take kindly to new policies, but they are foremost in suggesting and urging them. The expert is far more well informed as to new devices adopted in any part of the civilized world and to weigh the merits of them, than the non-expert.

I remember, not long ago, delivering an address before a club of business and professional men as to the application of the merit system to the selection of high-grade experts. I saw one prominent man before me with his face set in stern disapproval from the beginning. After the address, he made the remark that "it is absurd for anyone to suggest selecting men for such positions by a scholastic examination of questions and answers," and wondered that "a man of my position should advocate it." The truth was this gentleman had shut his mind up into idea-tight compartments, proof against the percolation of a new thought. It is this state of mind which prevents many people from examining into the civil service method which I have just now laid before you.

But after all the best proof of the pudding is in the eating. If this were all a matter of theory which had never been tried before, or perhaps only in one or two instances, I should blame no man for considering it highly theoretical, just as old sea captains and river steam-boat navigators thought it was impracticable to cross the Atlantic Ocean in a vessel propelled by steam. Should any such captain continue so to think after the ocean had been crossed many times every year for fifteen years in succession with success and improved speed and economy, ought not that captain to be considered antiquated indeed? So it is with anyone who doubts the applicability of the civil service system to the selection of engineers unless, indeed, he is absolutely ignorant of how often we have crossed the ocean of spoils politics in safety by the advanced methods of the merit system.

The first position to which it was applied, about fifteen years ago, was that of the supervising architect of the United States, a position of the very greatest importance and high salary. Then it

was successively applied to the selection of the heads of many of the Bureaus, especially those of the Agricultural Department, for which positions men of high scientific education in their specialties and executive and organizing ability were required, and the success with which these departments have been established and carried out is the best proof of the applicability of the system. Among other positions I may mention that of the head of the United States Bureau on Road Building and Road Materials.

In the city of Los Angeles the enormous water supply that was to cost many millions was put into the hands of engineers selected in the ordinary way. The work was going to pieces, little was accomplished and an enormous amount of money had been wasted. Then the board in charge was re-organized and all the engineers from top to bottom were selected by the civil service system, and after that the work was accomplished rapidly, economically, without taint or fraud, and with the most complete success.

Even assistants to the attorney-general at Washington and assistant solicitors and attorneys in States have been selected in this same way; also the chief engineer of the city of Chicago, engineer in charge of bridges, city auditor, the chief street engineer, the building inspector in chief, and numerous other officials with salaries from $5000 to $8000 a year, and lately in Philadelphia the chief engineer and his assistants for the new subway development and other experts with salaries even as high as $10,000 a year, the heads of departments, with one or two exceptions in Colorado, the secretaries and chief examiners of civil service commissions in several States have also been chosen by this same process.

The division engineers in the State of New York who are required to have charge of the construction, re-construction, maintenance, and repair of State and county highways are now under the civil service system with the full approval of Commissioner Carlisle.

In Kansas City the chief engineer, the assistant chief engineer, the superintendent of streets, and some other positions have been appointed through competition, and in New York City the chief engineer of the board of estimate and appointment is under the competitive merit system.

Indeed, these are only some of the many examples which I could give you. In addition to that, I may quote Lieutenant James Reed, assistant director of the department of public works of Philadelphia, in a paper read at the last meeting of our National Civil Service Reform League. He not only commended this method of selection as having worked with perfect success, but he also showed and proved that by this method of the selection and retention of experts, the municipal contracts had been taken out of politics in Philadelphia—that city long known as being under the domination of political contractors.

Some objection has been made to the merit system because of an alleged difficulty in removing a classified employee. We claim that

it is generally easier to remove for good cause under the merit, than under the spoils system. Under the spoils régime, an employee put in by political influence often could not be removed by his official superior even for drunkenness and insubordination. The superior who tried to remove him would usually find him re-instated, or his own official head in danger of coming off. It was easy enough to remove after a change of party or party faction—too easy for both good and bad were turned out. It is only in the New York City police force that removals for cause are difficult. There, against the opposition of the National League and the New York Civil Service Reform Association, an appeal to the courts with a complete revision was allowed, but elsewhere the usual rule requires only a statement of the reasons for removal in reasonable detail to be given the employee, with a chance to answer in writing, just to avoid removal under a mistake as to the facts, but the appointing officer has the final power.

Fixing of the powers of these experts is a matter of legislation and not of civil service reform, but at the same time, the selection and retention by the civil service method will give them such independence of position, such freedom from any question as to how the next election is going, and such absence of control by politicians that any powers granted to them by law can be exercised with an amount of independence which would be impossible without the tenure that the civil service system gives them.

It is true that some of the experts in German cities, in the city of Paris, and in the cities of Great Britain are not strictly under civil service rules, but they are under restricted methods of selection, partly from custom and partly by statute law very closely allied to the system that I have just explained, based on competition and the possession of education and experience that produces practically the same results by methods which are first cousins to the civil service system, and I need hardly say how vastly better and more efficient is municipal administration in those municipalities in which all the operative work is in the control of these prominent, highly trained, and efficient experts.

In the national government of Great Britain all the experts of that board that has control of municipalities called the "Local Government Board," and the permanent heads of all the great national departments, such as the treasury, postoffice, foreign affairs, and the like are strictly under the competitive civil service rules.

It is important that the civil service commissions should themselves be free from political considerations. Besides having their chief examiners, secretaries, and other subordinates under civil service rules, the plan of having the civil service commissioners appointed for long tenure, say six years, with overlapping terms is recommended and in some cases already adopted.

Lastly, may not the plan of having all the governmental work in the control of high-grade experts, free from politics, be the final

solution for securing efficiency and economy in public undertakings? May it not be the anti-toxin for public waste and corruption? May not the great success of the United States army engineers in the harbor and river work and in the Panama Canal be because these army engineers are so free from political pressure and have so secure a tenure of office, rather than because they are superior as individuals to the civil engineers of our country?

If there be any truth in these ideas, is this not a cause well worth promoting with all our influence, patriotism, and enthusiasm, not only in road building but in all other governmental enterprises?

SUMMARY

For fifteen years civil and sanitary engineers, architects, physicians, superintendents of streets, chief librarians, heads of bureaus, etc., men of scientific or special training and executive and organizing ability and high professional standing have been obtained through the civil service examinations. This is possible because those "examinations" consist, not of the scholastic questions and answers used for clerks, but of inquiry addressed to the candidates and to those who have employed them as to what education, training and experience they have had, their achievements in life and manifestations of executive and organizing ability and power to get on with and handle men. This inquiry is conducted by the aid of appropriate specialists of high reputation. To the inquiry is added a thesis on the conduct of the work to be done and sometimes an oral interview to ascertain personality. Such up-to-date methods form the clue for "taking the roads out of politics."

THE CHAIRMAN: The next paper will be on "The Sound Administration of Public Service," by the Chief Examiner of the United States Civil Service Commission, whose actions we, as a league, have watched and have never once found fault with him, but he has secured our admiration as a man who is constantly pressing forward new ideas for the benefit of the public system. I take pleasure in introducing Mr. George R. Wales.

SOUND ADMINISTRATION OF PUBLIC SERVICE

BY GEORGE R. WALES

Chief Examiner, U. S. Civil Service Commission

Any mention of the subject of road building brings to my mind recollections of boyhood days on a farm in Vermont. There we had in operation a system of road building which was an excellent example of the way not to do it. It was supposed to be a system of road construction, but it was actually a system of road destruction. I am told that this system, with slight modifications accord-

ing to locality, is still is vogue in many parts of the country. Doubtless you are familiar with it. A road tax was levied against each farmer, and he had the privilege of paying the tax in cash or of working it out on the roads. Cash being scarce, and time plentiful, the farmers unanimously decided to work out, rather than pay up. So a day was set aside for a road building bee. But it was a day of celebration and jollification instead of a day of hard labor for the public good. It was a holiday set aside to celebrate the highways. Like Thanksgiving and Christmas and the Fourth of July, it was a day of joy and good fellowship. Everybody had a glorious time and the road taxes were charged off the books.

But there were a few zealous, well-meaning souls, who were conscientious in their performance of their public duty and who felt that the other taxpayers were only cheating themselves by failing to give an honest day's work. These faithful ones brought forth their teams and, with plow and harrow and scraper, diligently fixed the roads. Oh yes, they fixed them. They fixed them so that the mud in wet weather and the ruts in dry weather were deeper and more plentiful then before.

No argument is needed to convince the members of this Congress that road construction should be placed in the hands of trained and competent men. There was a period in the history of our country when it was necessary that the settlers and farmers should build their own roads on which to haul their produce to market. In those days farmers and their wives were obliged to do many things which they can now have done for them in an infinitely better and more economical way.

There is another system of road construction which is, to say the least, equally as inefficient and much more extravagant than the one whereby the farmers build the roads for themselves. I refer to a system whereby road construction is made the prey of political favoritism, either local, county or State. We cannot have good roads, constructed and maintained economically, if their construction and maintenance are to be influenced by political expediency. The work must be divorced absolutely from political considerations and put upon a business-like basis of efficiency.

I am told that with the exception of two or three States the work of road construction and maintenance in this country is being parceled out, not to those who have the ability to perform it properly, but to those who have the ability to control a few votes. One of our leading periodicals recently characterized this system as a species of graft. Perhaps a more precise term would be highway robbery—the system robs the people of their highways and their money at the same time.

A plan has been proposed by members of this body whereby each State may take its road building operations out of politics and place them under a proper system of administration—an administration which will insure to the people one hundred cents' worth of road-

way for every dollar expended in taxation; an administration which will place the building of the roads in the hands of technically trained experts who have made this science their life work; an administration which will enable the people to realize all those great benefits in education, prosperity, and improved country life that will result from an adequate system of modern highways. Briefly, the plan is for each State to place general supervision of its roads in a non-partisan board, that is, a bi-partisan board and hence non-partisan in its action, under whom there shall be a State highway engineer with assistants and a highway engineer in each county, or a group of counties when a single county cannot afford to have an engineer, all of these engineers, from the State highway engineer down to the county engineer, to be appointed from those graded highest in a competitive examination testing the qualifications of all applicants for the places, and all of them to hold office during good behavior and efficient work.

A little over thirty years ago the national government established a system of competitive examinations for filling appointive offices. Before that time appointments were based almost entirely upon political considerations, ability to do the work being a secondary consideration. Upon a change of the party in power it was the practice to turn out those in office, whether or not they had in their period of tenure learned to do the work, and to put in their places a new lot of incompetents. The people tired of this farce and demanded that competition for appointment should be upon the basis of ability to do the work, instead of the ability to get votes. I do not wish to be understood as claiming that every individual appointed under the patronage system was incompetent. There were just enough exceptions to prove the rule. Spurred by a mighty insistence from the people, Congress enacted a law, calling it "An Act to improve the civil service of the United States." It provided that appointments should be made according to grade from among those graded highest as the result of open competitive examinations, and that the examinations should be practical in their character, designed to t st the capacity and fitness of applicants to perform the duties of the positions to which they sought to be appointed.

At first the competitive examination system was applied only to a comparatively few positions, mostly of a clerical character, numbering less than 14,000. But the law gave the President power to extend its operations to other positions, and from time to time the Presidents have extended it, so that now it covers almost all the positions in the executive branch of the government to which appointments are made without the advice and consent of the Senate. The extensions have not been confined, however, to presidential action, for growth in the government business and extension of its operations and investigations to new fields have gradually increased the number of persons who hold office under the competitive system in the service of the United States. At the present

time approximately 300,000 positions are classified under the national civil service law.

It seems to me that this growth in a period of about thirty-two years is alone sufficient proof of the efficiency and absolute success of the system. We have, however, the direct testimony of men who have been in position to know the facts—those responsible for getting out the work—that efficiency has taken the place of inefficiency, and economy has taken the place of extravagance, wherever this system has been applied; that the volume and accuracy of the work done by each employee have increased amazingly. We know from the records showing the number of pieces of mail handled by each employee of the railway mail service that in that one branch of the government's work the competitive system is saving to the taxpayers several millions of dollars annually and at the same time handling the mail with a marvelous increase of accuracy. To be more exact, the figures show that each employee is doing 20 per cent more work than under the old system and doing it with one-third the number of errors. Again, and as further proof of the success of the competitive examination system, it is found that in those parts of the service where efficiency ratings have been made, there is an almost exact ratio between such ratings and the ratings received by the employees in the examinations through which they were appointed.

It is not my claim that the operation of the civil service law is, by any means, absolutely perfect. The law was humanly devised and is humanly executed. I do not believe the civil service system has a little millenium of it own which it has reached or will soon reach; but the law will compare most favorably with any other federal statutes in its shortcomings, which are rapidly lessening with the increase of public confidence in the sincerity and efficiency of its administration. It has seemed to me that some of the friends of the civil service law have had a mistaken attitude toward its operation and administration in respect to violations of the law. Utter amazement and discouragement is evinced by some person at a single violation of the civil service law, when frequent violations of other statutes are regarded with complete equanimity and indulgence and are taken as a matter of course.

Some years ago a clergyman, who happened to be also a very impractical man, came into the office of one of our commissioners showing great excitement and perturbation and exclaimed, "Mr. Commissioner, I find that your civil service law is actually being violated; you are actually not preventing violations of it."

The Commissioner glanced at the clergyman's card and replied, "I see by your card that you are a clergyman. Let me ask you a question. How are you getting along these days in enforcing the law of Moses; any violations?"

But I wish especially to call your attention to the development of the competitive examination method of appointment to profes-

sional and technical positions, positions of responsibility paying up to practically $5,000 a year—in other words, that class of positions comparable to the kind required for efficient highway administration. It was not until 1896 that any considerable number of such positions were brought under the system, and even at that time the number was small as compared with the number and variety of such positions now included within the operation of the law. It has been claimed that the success of the competitive system as applied to professional, scientific, and technical positions has made possible the great extensions which the government has made in recent years in scientific experimentation and investigations for the public welfare. However that may be, the increased activities of the government in these lines have necessitated the application of correct principles of competitive examinations for such positions in order to insure the success of this system of appointment The Civil Service Commission has simply been careful to apply common sense business principles to its methods of examination If a position of a technical character requires a man with technical training without much, if any, additional experience, the examination has been opened to those who have had the required technical training, and they have been given written tests in the subjects with which they should be familiar in order properly to perform their duties If the position requires a man who, in addition to a technical education, has achieved distinction and has become eminent in the line of his profession and who perhaps has specialized in some branch of his profession—one competent to devise, lay out and manage the work—then the examination has been so constructed as to bring men of that character to the head of the eligible list. An examination consisting of questions and answers on technical subjects would not be likely to determine the relative fitness of applicants for such a position; moreover, men qualified for such a position could not be expected to enter into an examination of that kind Therefore, for these high grade positions where men of experience and attainments are needed, an examination is given which does not require the competitors to assemble at any place or to answer technical questions. They are called upon to furnish, under oath, a detailed statement of their education and experience, including all the work they have done since graduation. They may also be asked to submit an original thesis or published works, and they are required to give the names of persons able and competent to testify as to their experience and personal fitness. Confidential inquiry is made by the Commission from various sources as well as of all persons referred to by the applicant. Gratifyingly accurate and discriminating testimony is obtained by this means of confidential communication. Such testimony approximates, if not equals, the testimony adduced upon cross-examination in judicial proceedings. The Commission has on its force of examiners men skilled in the weighing of evidence of this kind. It has a corps of expert examiners who are eminent and

leading authorities in their respective lines, whose services may be called in when needed. With such means it is not difficult to place upon the history of the career and accomplishments of each applicant a percentage rating which is an accurate measure of his relative fitness to perform the work to be done.

A demonstration of the ability of the competitive system to obtain high class men for technical positions has been made within the past year, in connection with the employment of men to appraise the value of the property of common carriers in the United States. For this work the Interstate Commerce Commission required men with qualifications ranging all the way from rodman and chainman to the senior positions in civil, mechanical, structural, electrical and architectural engineering, as well as motive power men and expert accountants. There have been approximately 15,000 applicants for these positions, and the task of sifting the wheat from the chaff and of grading the wheat after the sifting was one of considerable magnitude; but it was done, and it was done so well that the Interstate Commerce Commission expressed its gratification to find that it could secure a force so well equipped to perform the gigantic task of obtaining an accurate appraisal of the value of common carrier property. A system which can successfully secure a competent force of high grade engineers for this valuation work could surely provide the proper kind of men to have charge of the construction and maintenance of public highways.

A large number of other instances could be cited, demonstrating the absolute success of the competitive examination system when applied to highly expert and technical positions. Among such positions are, assistant director of the Office of Public Roads, senior highway engineer, assistant in road economics, petroleum engineer, chemical engineer, mineral technologist, chief metallurgist in the Bureau of Mines, associate physicist in the Bureau of Standards, professor of chemistry and professor of pharmacology in the Public Health Service, assistant chief of the Bureau of Chemistry in the Department of Agriculture, chief irrigation engineer for the Indian Service, experts in the Children's Bureau, and many others, all ranging in compensation up to $4,800.

The competitive system has grown in States and cities as well as in the national government. It has grown in the extent of its operations and in popular favor as well, and it is constantly gaining friends as the people come more and more to understand its principles and to apprecite its benefits. It has now become so strongly entrenched behind public sentiment that partisan administrative officers are afraid to admit that any changes they may make are influenced by political considerations, and are careful to claim at least that all such changes are for the purpose of improving the efficiency of their officers. Wherever the adoption of the competitive system has been submitted to a referendum vote, it has come out victorious.

The States of New York and Massachusetts were among the earliest to adopt the system for appointment to State and county offices. New Jersey has, within recent years, put it into operation in much the same comprehensive way that it has been established in Massachusetts and New York. These three States, I am told, are leaders in highway administration and they can be taken as examples of what the competitive examination system will do for the good roads movement.

This great organization of representative men from all parts of our country can do much toward increasing the popular understanding of what the competitive system is and what it accomplishes. That there is a need for a still wider popular knowledge of it is shown by the need for its application to the good roads movement in the States where it has not been applied.

In its beginning the competitive examination system was largely, if not entirely, a system of entry to public employment, coupled a little later with tenure during good service and good behavior. Latterly it is broadening definitely into a system of administration. A civil service commission today might more properly be designated a department of administration. Only through the administration of a civil service commission is it possible to have the most efficient and economical management of all the various departments and branches of the public service. It is essential, however, that the conception of public positions as patronage be displaced by recognition of the fact that public business at all times is the business of all the people. Public positions should be held in trust for all the people. With this purpose the competitive examination system is particularly in harmony, for it opens the door of the public service to the competent and worthy and closes it effectually in the faces of the unfit and the unworthy. This system is needed wherever public business is to be done.

THE CHAIRMAN: Gentlemen, I noticed in the discussion this morning something was said about the power of removal, and a good many people who, sometimes from political motives and sometimes from ignorance, have tried to make out that it is impossible or hard to remove a man from the civil service that is classified under its rules. Let me state that experience has shown that it is easy to remove a man for good cause under civil service rules. Those of us who have watched the civil service for years back have seen many instances of persons who have been dismissed by the official in charge for drunkenness and insubordination, for example, and had that person put back again by some political superior, so that the man directly in charge of him no longer had any control over his actions. Under the civil service system, all that is required in the national service and as far as the national league has ever approved of, has been that the party to be removed be furnished with the reasons in writing, sufficiently explicit for him ot

understand them, and be given an opportunity to reply in writing, with the appointing officer in the end making the final decision, merely to prevent the head officer making the removal from acting under some misstatement or misinformation. We will now pass to the next paper, "The Applicability of the Merit System to the Engineering Service," and may I state that the reader of this paper is now the Chief Examiner of Philadelphia and was appointed as the result of this very kind of competitive examination. He had been the Chief Examiner of Kansas City and his record showed such splendid work that he stood at the head of the eligible list, and exemplifies today an expert receiving his position by strict competition. He is one of the best chief examiners that we have in any of our municipalities—Mr. Arthur M. Swanson.

THE ADAPTABILITY OF THE MERIT SYSTEM TO THE ENGINEERING SERVICE

By Arthur M. Swanson

Chief Examiner of the Philadelphia Civil Service Commission

It would, no doubt, be interesting to you men who are practical road builders to know how we choose our laborers and skilled laborers for work on streets by the merit system. Take common laborers: We receive applications at any time, then when there is a need for more laborers on the street we notify perhaps a thousand men who have applied to appear in groups before the physicians who are on the staff of the civil service commission. They are given a sort of inspection by these physicians simply to see that they are able-bodied men, their lifting strength is tested, and their eyes, ears, heart and lungs are given a fairly close inspection. The physicians then group the men in four classes. The first class is marked 90, the second class 80, the third class 70, the fourth class, which would be the ineligibles, are marked 60. The appointing officers then are required to appoint these laborers in the exact order of their standing on the eligible list. Suppose we need pavers, for example, the applicants are taken to one of the yards of the Highway Bureau, usually to the yard where the bureau would like to have some paving done, and the applicant is supplied with the necessary materials and tools and a helper is required to pave for, perhaps, an hour or an hour and a half, and we have present a practical paving foreman from some private corporation to assist in passing judgment on the men.

However, I wish to confine my remarks principally to examinations for engineering positions of a somewhat higher character and I shall take up and discuss two or three such positions.

Chief Engineer, City Transit. This position pays $6,000. The incumbent has charge of all engineering work pertaining to the

construction of the great subways and elevated lines now being undertaken by the city of Philadelphia. Our idea is that a written examination upon technical problems is unsuited to an engineering test of this grade. We believe in adopting as nearly as possible under the laws the method of selection which the head of a corporation would probably use. Of course, public positions cannot be filled in altogether the same manner as private positions may be for the reason that every citizen has a right to compete for the public position if he desires to do so. We first selected an examining board composed of the assistant chief engineer of the Pennsylvania Railroad, an engineering professor in the University of Pennsylvania, and a private consulting engineer. An announcement was then issued stating the character of the position, the type of man wanted, and the conditions of the test. These conditions were that the applicant should first submit a complete statement of training and experience, together with copies of any papers or books he had published. This statement of training and experience involved age, education, previous employments, work designed, supervised or constructed, membership in engineering societies, papers or lectures published and other pertinent information and professional or business references. All who received a rating of 70 per cent or more on that subject were admitted to the remainder of the test, which was an oral discussion of appropriate engineering topics with the examining board, after which a second mark was given. These two marks were averaged for the final standing of the competitor, 60 per cent being allowed for training and experience and 40 per cent for the oral test. An engineer of excellent standing, who had previously designed some of Philadelphia's noted public works, among them the famous Walnut Lane Bridge, was the successful competitor in this test and was appointed. There can be no doubt that successful professional men, including engineers, hesitate to submit to a civil service examination as that term is popularly understood. The word "examination" conjures up visions of cramming volumes, and puzzling queries upon text book theories. But the modern merit system is none of this. The effort nowadays is to devise a type of test that is adapted to the job to be filled and one that will attract successful engineers by the sheer fairness of the plan as well as repel the unsuccessful by the hopelessness of its miscarriage through their success. We feel that the test above described did measure up to the job and it produced a successful engineer.

District Surveyor. This position pays $4000. The incumbent is in charge of all city planning within his district, including streets, sewers, parks, and all similar things. He is not necessarily an executive, but rather a technical man. Again we started by selecting a board of special examiners similar to the one described above. They divided the examination into three parts, namely, experience 30 per cent, thesis 40 per cent, oral interview 30 per cent. Only

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those who attained 70 per cent on each of the subjects of experience and thesis were admitted to the oral test. Applicants were not assembled at any time. The experience questions and the subject for the thesis were widely distributed among engineers and applicants were given about thirty days in which to prepare and file their work. This means that the candidate had at his disposal all his usual references and other equipment and made the test a matter of actual engineering practice.

The subject for thesis is worthy of mention. It consisted of a contour map of a proposed addition to a city, with the following instructions:

Prepare a development plan on tracing cloth, of the 126 acre tract "Rockland," on which shall be shown the best arrangement of streets, as determined by a consideration of all the conditions given in these directions and otherwise expressed on the topographical print.

Place upon the plan: (a) The street widths. (b) The two main dimensions of blocks as determined by scale. (c) Elevations of the intersections of center lines of all streets, and all points on center lines where there are important breaks in the grade. (d) Indicate the gradients. (e) The names of all streets. (f) Show lot divisions in each block indicating the principal dimensions. (g) Number the blocks. (h) Indicate the water distribution system with kind and size of pipes. (i) Consider sewerage and storm drainage. (j) Show the drainage system or systems on the plan, give the sewer sizes and gradients and construction. (k) Indicate the paving or wearing surface for each street.

Prepare a Report and Recommendations: (a) Showing and explaining the reasons for the proposed development. (b) The explanations to cover the street and lot systems. (c) The sewer and water systems, explaining in some detail as to the sizes, gradients, street widths and locations. (d) Explain the maximum and minimum gradients of streets and sewers. (e) Explain the sewer depths. (f) Explain the selection and construction of the pavements recommended. (g) Explain the special features in the design that particularly add to its value.

Conditions That May Influence the Development: Location—farming and grazing district; about one and a half miles from a busy town of 75,000 population. The next nearest town is the county seat. Nearest railroad station two miles on double track road. A few suburban streets are proposed for the area on the south side of the railroad opposite the easterly end of "Rockland." Two or three small houses are near the iron works, and about 400 feet south of the railroad. Iron works are about 200 feet south of the railroad, employing 200 hands. Consider rainfall only on the area of the tract, at the rate of 6 inches per hour for the first twenty minutes of cloudburst. Small springs on tract of no account for water supply. Nearest water is a mountain stream about 1500 feet south of the railroad, flowing about 200 cubic feet per minute, of a slightly turbid water. All the region about the tract is of a clayey soil. The area to the south of "Rockland" is mostly flat with a slight slope to the river; nearly open ground.

Computations to be Performed as a Part of Thesis Work: Block "Norfolk"—Compute and indicate the dimensions of all the lot outlines to the nearest one hundredth of a foot, and all other dimensions needed to complete the calculations of the subdivision. Indicate all the courses and distances so that the block and lots can be correctly laid out in the field. Present the individual calculations for all the work in neat schedule form, so that the examining board can inspect readily. Place the results of the computations upon the print in black India ink.

I might add that affidavits were, of course, required as to the originality of the plan and its execution. Eighteen engineers com-

peted, of whom four were finally passed. It may be interesting to state also that the oral interview consisted largely of further explanation of the plans by the competitor and also a series of questions upon the ethics of engineering. I think we are often unmindful of the necessity that the ethical side of the situation be stressed by an examining board in the case of an important public position. The director of public works added his apparent approval to the test by appointing the first man on the eligible list. This illustrates what may be considered another successful adaptation of the merit system to the job to be filled.

Draftsmen. Tests for the engineering service acquired a questionable standing in the minds of many by their very insufficiency in former years. The records of our office show that not many years ago draftsmen, for example, were tested by such questions as "Name the tools a draftsmen uses," "Define Plane Trigonometry," and similar queries. But there has been a development. Our method today is as follows: We give two days to the test. The first day is devoted to computations upon a chosen set of facts or data of an intensely practical kind. At the close of the day's work the applicant is required to place his results on a separate sheet. He is furnished with all the necessary hand books and tables and permitted to use slide rules for checking purposes. So far as possible no man in the engineering service, be he chainman, rodman, draftsman or engineer, should be given a test without access to all the usual equipment of his profession. If an examiner can't test a man without searching him and imprisoning him through the ordeal, he isn't equal to his job. The next day the applicant is required to bring his instruments. His tabulation of results is returned to him. We provide drawing tables, boards and papers and he is instructed to prepare a finished drawing from his results. Surely this will not be classed as a theoretical "examination." It is simply two days of the life of the ordinary draftsman taken as a standard for measuring his capabilities and this is not a bad conception of civil service tests today.

Age and Education. We hear much criticism leveled at the merit system to the effect that nobody but a college professor or a young man fresh from school can pass the tests that are given. The facts do not support the claim. We have taken a given year and tabulated the facts including all engineering tests from chainman to chief engineer. Of those passing, 28 per cent had a college education, 34 per cent had a high school education while 38 per cent had only common school training. At the same time, of those failing 20 per cent had college education, 23 per cent had high school training, and 57 per cent had only common school education. In fact, the man who made the highest average and was appointed to the highest engineering position for which I have ever supervised a test, had been denied even a high school training. In the test for district surveyor described above, the average age of those passing was 40

and of those failing 42. All of the four men who passed that test had a college training, while of the fourteen who failed nine had college education. A close study of these and other statistics will show that as a rule there are very seldom any unnatural results in this regard. Thus the merit system establishes its intense practicability in that it does not operate to the detriment of the mature and practical man and the undue advantage of the young and the theoretical.

The Merit System a Necessity. Three years ago the highway bureau of Philadelphia expending and supervising millions of dollars of public work annually had hardly a single actual engineer in its employ. Even the highway inspectors were very seldom men of even the slightest engineering experience or training. Civil engineering training and experience is now made an absolute requirement for this position by the civil service commission. Today the bureau has 20 engineers. It has also 160 engineering inspectors and highway inspectors, of whom about 140 are civil engineers by both education and experience, those lacking such training being holdovers. And every one of them from the chief at $6000 a year down the line is a product of the merit system of civil service. To thus transform a bureau requires that the department of public works take the initiative by creating a change in the type of service wanted, but the merit system has delivered the goods and thus played an important part in creating a field in Philadelphia for highway engineers, and, when necessary, we have gone outside the city to find the right men. Let me say that the question of residence should never be permitted to prevent a city from securing the highest degree of service. What you need is to build up a body of trained road builders in this country and you can't do it so long as local residence is a requirement for public service. I do not know of any way by which a technical service can so satisfactorily be created and maintained in public service other than through the merit system intelligently applied to each job to be filled.

New Developments. As a further proof of our own conviction that the merit system is practical, let me state that we publish every one of the questions after the examination is completed. This is done for a threefold reason: It is a scheme of education, it is convincing proof of fairness, and it compels the examiners to keep abreast of the great progress being made in the varied branches of engineering and on the alert for new questions and new tests. Perhaps the thing that would do more to convince this Congress of the adaptability of the merit system than all the addresses that we can deliver would be to read these questions in full. If there is any interested person who will write me, I will send him a copy of every question asked during 1912 or 1913. Not only that, but we keep every applicant's examination papers open for public inspection with the marks of the examiners thereon at any time after the results are published. The examining department has a library of the latest and best prac-

tical reference works on engineering that can be had and subscribes for and reads the best engineering periodicals. It does not purchase books of stale questions with cut and dried answers. The engineering examiners are university graduates with considerable practical experience. I mention these apparently unrelated items merely to show that modern civil service administrators are alive to their duties and are keeping up with the progress of the engineering profession.

The developments in the methods of the merit system in recent years have been nothing short of remarkable. Especially is this true when we consider the difficulties under which the system has labored and advanced. Let me suggest that the necessity of arguing here today the adaptability of the merit system to the engineering service does not arise from any errors in the principles upon which it is based, but rather from the way in which it has been handled from financial and administrative standpoints. Small wonder is it that its adaptability should be questioned when we recall that large cities pay higher salaries for court criers and writ servers than for engineering examiners who must prepare the tests and rate the qualifications of engineers for the public service. Fortunately, there are everywhere eminent engineers who recognize the value of the merit method of selection, and who, therefore, give their time and ability free of charge as special examiners. And when we add to this the frequent setbacks it has received under unsympathetic administrations, particularly in States and municipalities, we have an idea of its struggle for a permanent place in the plan of government. That it has survived and prospered under such conditions is the strongest proof of the correctness of the idea.

Creating a New Engineering Department. But the greatest test of the adaptability of the merit system does not come in the filling of individual positions, but comes rather when a department composed of only engineering positions is suddenly created by the legislative body and the responsibility for immediately filling those positions to satisfy an insistent public demand for action is put squarely up to the merit system. This has occurred recently in Philadelphia, and never did the merit system of civil service show itself to greater advantage.

The department of city transit was created a little more than a year ago by the act of the Legislature. It was created to supervise and control the construction and operation of great subways and connecting elevated lines to be municipally built and owned. A complete staff of about 140 engineers, draftsmen, transitmen, rodmen and chainmen had to be selected, and the character of their work was such that no existing eligible lists could be used. In other words, the merit system was called upon to produce a new engineering department for a new line of municipal activity at once. Examinations were immediately announced, the duties of the various positions stated, and the desired qualifications fixed. The number of

applicants was large, but first class engineers in private business willingly gave their services as examiners, and to make a long story short, there was never a time since the creation of that department when the civil service commission was not able to fill all requisitions for appointments. Although the director is allowed by law the selection of one name out of four, it is a testimonial to the effectiveness of the merit system that he chose his men almost invariably in the exact order of their standing on the eligible list. There were thus selected and appointed in that department within a short space of time sixteen engineers, whose annual salaries range from $1,500 to $6,000, and forty-two draftsmen, whose annual salaries range from $1,000 to $2,700 besides a number of checkers, rodmen, chainmen and tracers. As a matter of fact, this new department, created from top to bottom through the merit system, is perhaps, today the best equipped and best organized engineering bureau in the city of Philadelphia. We may spend many millions for subways and elevated lines but we have taken the precaution to lay the foundation for the supervision of that expenditure in the merit system.

The Appointing Officer's View. Perhaps it might be interesting to illustrate what the appointing officers think about the efficiency of the merit system of tests as indicated by their appointments from lists. Take, for example, highway inspectors. In a little more than the past year 114 eligibles have been certified to the bureau of highways as highway inspectors. Under the law the chief is not required to appoint more than four out of each seven. As a matter of fact, out of 114 names he has appointed 98, although the law would compel him to appoint only 56. And the first man has been appointed on every list but one. In appointing 35 draftsmen the chief of the Bureau of Surveys has passed over only nine names, when he could have passed over several times that number without violating the law. In a little more than a year nine eligible lists have been created for highway engineers at various salaries from $1,500 to $4,000 a year. In eight of the nine cases the Bureau of Highways has appointed the first man on the list. Not only that, but in one case, for example, they have appointed eight out of the first nine on a list. These bureau chiefs were thus by no means taking advantage of that provisions of the law which enables them to pass over three names out of every seven, and it must be borne in mind that they are not making their appointments practically straight down the lists in order to glorify the civil service system. It is only natural and proper to presume that their purpose is to render successful administrations of their bureaus by getting work done and getting it done right. It is most convincing proof that the merit system properly discriminates between the competent and the incompetent in the engineering service.

You will note that in this short paper I have necessarily limited myself to a discussion of original entrance to the service and have omitted other important matters, such as protection in tenure,

promotion and other things. The merit system has come to stay and its the rock upon which any stable and efficient engineering service must be built and maintained.

THE CHAIRMAN: The subject is now open for general discussion.

MR. PATTERSON (of the Prison Commission of Georgia): We have had under consideration for some time in our department the selection of road engineers to assist the various counties in Georgia in their road work. I was extremely interested in hearing this discussion, because we have been somewhat at a loss to know, when we employed those men how and where to get them. The law provides that these men employ not more than four supervisors who shall visit the various counties, inspect the convicts in their work and perform such other duties as may be required of them by the commission; also that it shall be the duty of the supervisors to inform themselves thoroughly upon the subject of road building, etc., and in the economical handling of convicts. It provides that the salary of those men shall not exceed $1800 per year and expenses. Now how can we get—what kind of method could we employ to get these experts, who shall be civil engineers, if possible, but who shall be experts in this line of work—to give this assistance to our various counties in Georgia? The weakness of the system in Georgia is the fact that the State does not provide this expert assistance. Our counties are working their roads by convicts and some of them do not feel financially able to secure expert engineers to put in charge of this work, but the law provides that the Prison Commission shall employ four experts who shall visit the various counties, spend as much time in them as possible and instruct the men in handling their convicts, building their bridges and doing the engineering construction for these various counties. What kind of method can we employ to get competent men?

MR. SWANSON: Who has the appointing power?

MR. PATTERSON: The Prison Commission. I am a member of the Prison Commission.

MR. SWANSON: And the work is temporary?

MR. PATTERSON: No, it is permanent and the salary is $1800, and expenses; it is equivalent to a salary of $3000, if a man pays his own expenses.

MR. SWANSON: I understand they are employed both winter and summer?

MR. PATTERSON: Yes, the year round.

MR. SWANSON: Well, I think if you could do it, the first thing to do would be to set aside any idea of residence within any particular county or even within the State. Would these men be confined to a single county?

MR. PATTERSON: No. There are just four of them and we have 120 counties working convicts; each man would have charge of the supervision of the work of 30 counties.

MR. SWANSON: It seems to me if your Prison Commission would appoint a board of high class engineers within the State, say three men whose fairness of mind you could count upon and whose interest in the work was real and genuine, and then proceed very much the way we do with the civil service examination, that is, issue a notice which might be put in various papers within the State, and if you decide to set aside residence, put the notice in such papers as the *Engineering News*, *Engineering Record and Manufacturers Record*, outside the State—a short notice describing the kind of position you are going to fill, the salary and the method by which it will be filled and giving such assurances as you can as to the tenure of office, and then specify when and where the men should send their applications. That will be a preliminary step. Now, if you have not had much experience with examining people, it seems to me that an examination consisting of a consideration of their training and experience, together with an oral interview before such a board as I mention, would be the proper way to do it, because in those supervisory positions where men have charge of other men as these men would have, I want to say to you that it is very largely a question of what a man has done and what his personality consists of. I want to urge upon you the importance of the personality of a man in a position where he has supervision, and the only way to get that is by an oral examination before some perfectly fair and honest board that you might designate. I should say that all applicants might be requested to send in statements of their training and experience. These could be gone over by this board and such of them as seem to be worth while could be sent for to be interviewed by the board on a certain day and then the board could grade and rank them on a list that you can appoint from. If you have no civil service law, then in your original announcement you ought to specify a method of selection and that you are going to take them exactly as they stand on the list or are going to take one out of three so that a candidate would have some assurance as to how he would be treated if he came as a competitor.

MR. PATTERSON: The University of Georgia and the Georgia School of Technology both have departments of engineering; would the heads of those departments make good examiners?

MR. SWANSON: Yes, sir. I would try to draw into the work, besides those men, men who are out in the world on actual construction; I would not make a board altogether composed of college men.

MR. PATTERSON: I see. That is just the information I wanted.

MR. A. R. JOHNSON (of Tennessee): I desire to ask this question; I gather from the statement in regard to the painters of Philadelphia, that they selected those men who showed the most efficiency at the time the work was done. Now suppose we take the average proposition up in my county of building roads for the first time. We want engineers, of course, and we want contractors. I think you have answered the engineering part of it fully, but what, if any, examination should the contractor stand and what efficiency should he show before he is employed and the work turned over to him.

MR. SWANSON: Well, that is entirely a new problem. I have never had any experience with it, but I should say it seems to me that you could get that from the reputation of the contractor in his community, through first class business references which he might be able to give and through an examination into the jobs that he has had and the way in which he has done them. I think it is more a question of the standing of the contractor in his own community in that case. I understand that you mean the man to whom you are going to let your contracts and who is going to do your work?

MR. WALES: Do you want to know if you are going to select that contractor from a number of people, how you would hold him responsible?

MR. JOHNSON: We have tried to hold him responsible by contract and have failed. I am so much delighted with the talk this evening on the merit system that I thought I might take some little of it and apply it in getting contractors to do the work that we propose to do over in Tennessee. I want a man to do it that is capable and will go along and do it. Now as to his capability, I wanted to get some idea as to how I would know. That is what I want to carry home with me.

MR. WALES: There would be no competitive selection, of course.

THE CHAIRMAN: I suppose you would have him give bond for the good performance of his work and would have competition. Would not your engineer draw up some system of competition for the work that these various contractors would bid upon?

MR. JOHNSON: Yes, that is true, but from your statement I gathered that there's thousands of dollars wasted on these contracts and I want to avoid that trouble.

THE CHAIRMAN: Then have a good engineer appointed who will inspect the work properly before payment is made.

MR. LEECH (of Ohio): It seems to me that the worst stumbling block in the way of the merit system is the question of local residence. It is very little trouble for a city the size of Philadelphia to find within its boundaries sufficient well trained engineers to fill the vacancies, but in some parts of our country, or some of our smaller villages, there is not within them possibly a well trained engineer. The legislatures, in forming a great many of our laws, provide that the villages or the mayor shall appoint a civil service commission and they in turn hold a competitive examination, and quite frequently, within that very village there is not more than one or two, at most, that are qualified to compete. The result is that we get the same men who have been doing the work right along. There is really no competition, and no increased efficiency. It seems to me that it would be well if we could get away from this local residence phase and open up the examination to the capable men, let them come from Maine or California or from one extreme of the country to another.

THE CHAIRMAN: That is the course we advised and in arguing the question before some authorities who wished to limit the examination to residents, we made this argument, that if we bring in a man from another State and he is employed all the year, you have another resident that comes in and occupies new property, spends his money in your State and adds to its wealth, as every good, competent man does. In Massachusetts it is left to the civil service commission. They have full freedom to go outside, and in the higher positions like that of engineers, they frequently go outside the city and even outside the State. I understand that the same is true of Philadelphia.

MR. WHITNEY (of California): I am interested in this question of going outside your own county or outside your own State to select a competent engineer. In Sonoma County, Cal., about a year ago, there was a highway commission appointed for the purpose of looking into road conditions and to finally map out a road system for that county. I happened to be one of that commission, and after I assumed office, the question with myself and the other commissioners was, where to find a competent man to do the work. We had engineers in our county, or surveyors who thought they could do the work as we desired, but we were not satisfied that they were the men; consequently we commenced to look around

We could not resort to your civil service examination; we had no means by which we could do it, so we investigated the standing of different engineers in the State of California. Finally we went to San Joaquin County, where we found a young man who had been sent out to California several years ago by the Department at Washington. He was sent out to make a report on soil conditions of San Joaquin County. He made a report and about this time the county had concluded that they wanted a better road commission. They had formed their Good Roads Club and commenced their campaign and finally it reached the point where they appointed an expert engineer to do that preliminary work for them. They selected this young man who was sent out from Washington and he made the preliminary surveys, gave them their estimate and finally was employed and received a discharge from Washington. He was employed to go ahead and construct the roads in San Joaquin County. They had bonded for nearly $2,000,000. He came there and had charge of the work during its entire construction and we investigated the result of his work both by examining his road and by all the information that we could gain from every source possible, and after a thorough examination and investigation we concluded that he was the man we wanted and employed him. There was a condition in which we went from one county to another in the State, and selected a man for his fitness, and I think we were fully justified by the results accomplished.

MR. KING (of Memphis, Tenn.): This is a matter, gentlemen, that is going to adjust itself in the course of time. In the South this matter of the employment of engineers who superintend road construction is new and most of our road builders have thought that the position was a sinecure, an easy job; but we are getting away from that, and because they did think it was an easy job, they expected some taxpayer in the county or some son of a taxpayer to receive that job; but with us in Memphis, Shelby County, we are adopting not only the merit system but we are insisting that a man must give value received to the county for his salary, in labor and in skill. Now there is not a business man, commercial or agricultural, who adopt that plan of employing men who live only in the city in which he lives. So this old method and system of employing men to hold official positions merely because they happen to live there and are taxpayers—we are going to get out of that and our young men are going to prepare themselves for it; and I see, my friends, no very great trouble because we are now coming to the point where we are building roads scientifically, and we are employing skilled men who are going to give all their time to the work.

THE CHAIRMAN: There were two more papers scheduled for this afternoon and I am afraid we will have to close the debate if the

gentlemen who are to read those papers are here. The first paper is "Engineering Supervision of Road Construction" by W. S. Keller, State Highway Engineer of Alabama.

ENGINEERING SUPERVISION OF ROAD CONSTRUCTION

By W. S. Keller,
State Highway Engineer of Alabama.

This question confronts every commission that has the building of good roads, and it would appear to the business man that the wisdom of having an engineer supervise the expenditure of large sums of money on highway construction, would not be questioned any more than a railroad company would question the wisdom of employing an engineer to locate and supervise the construction of a railroad.

We may, therefore, for discussion divide this subject under two general heads:

Is engineering supervision of road construction necessary?

Why is an engineer better fitted to supervise road construction than a practical road builder who is not an engineer?

The average county commissioner has had no experience whatever with an engineer. He has, however, carried the rear end of a chain for the county surveyor, and, in unison with his colleague, the front chainman, cried "stick, stuck." He has a very exalted opinion of this man with the Jacob staff and compass who is able to follow land lines for a distance of three or four miles a day. Far be it from me to belittle the county surveyor. I would, instead, erect a monument to him as a martyr who receives a pittance for his labor and a "cussing" for his pains. We point with pride to the fact that the "Father of his Country" was a land surveyor, but we seriously doubt if he was competent to locate, and properly supervise the construction of roads

Engineering supervision of road construction is absolutely necessary and this statement is proven every day, positively and negatively, in this state of Georgia. A layman riding over the roads of Georgia can tell at a glance a road that has been located and built under the direction of an engineer. When he rides over a road that has been constructed along the old trail, located by the Indians and early settlers, without any regard whatever for grades and very little for drainage; he sees the hand marks of the commissioner, who saves his county the salary of an engineer, and spends it thrice over in useless work and expensive maintenance.

Despite the fact that a majority of commissioners or supervisors have had no training whatever in road building, they will concede to no one that they are not as well qualified to direct road work as any engineer they can employ. They will often admit that an engineer should locate and stake off a road, but they think his duty ends there. It is just as necessary that an engineer supervise construction work as it is that he should locate the road. How many commis-

sioners in the hearing of my voice can tell me how much it costs to move a yard of earth or how much it costs to install pipe of various makes—how much per cubic yard their concrete culverts are costing them? You may say we know how much per mile our roads are costing, why should we bother to know the unit cost? Why, my friends, does a merchant keep the unit cost of his wares? Because he desires to buy from the man who sells the cheapest. So, a county should know if its roads are costing more than they should.

The commissioners of a certain county in Alabama claimed that they were building roads as cheap or cheaper than any contractor could do the work. They had an engineer estimate the cubic yardage of earth moved for a certain period of time and to their surprise it was costing 37½ cents per cubic yard when the average contract price in Alabama for three years had been 23 cents per cubic yard. Authorities should know whether they are getting value received for their money, and an official who overlooks such a vital question, is not true to the trust placed in him by the people.

Many counties are imposed on in the purchase of material and supplies and are actually paying more for such in large quantities than individuals have to pay for the same in small amounts. This is usually attributed to either carelessness, politics, or a false idea some of the commissioners have as to their duty. I believe the duty of commissioners, in so far as road building is concerned (and it can equally as well be applied to other public matters) is to purchase with as much care and secure just as low prices as they would if buying for themselves as individuals, regardless of whether the goods purchased come from local or foreign merchants; of course, giving always the preference to local merchants, if their wares are as good and prices as low as those of outsiders. It is not the duty of road authorities to conduct county affairs so as to make money for individuals or to give jobs to political henchmen. If a competent man cannot be found within the borders of a county fit by experience for a position such as foreman, it is right and proper that a competent man should be secured from elsewhere.

The remedy for these ills is, unquestionably, to have some one in charge of road building qualified by education and training and free from political influences, who can be held responsible for results. Very few counties have commissioners or supervisors who devote all of their time and attention to their office, and it is self-evident that an engineer trained in road building will get better results than can any set of men who give only a few days in the year to their public office.

As to the second division of this subject, "Why an engineer is better fitted to supervise the construction of roads than a practical road builder who is not an engineer." First, an engineer is indispensable, even though you have a splendid layman to supervise the work. A large percentage of all roads to be constructed require relocation, profiles made, grades established and if the work is to be contracted,

the road must be cross-sectioned and the yardage of excavation and embankment calculated and made to balance as near as possible. Such work, a layman cannot do. Who is better fitted to supervise the construction of any job than the man who plans and specifies the work? The road supervisor is usually uneducated and it is practically impossible for him to correctly account for the expenditure of large sums of money and equally as impossible for him to keep cost account of his work.

This condition is usually brought about by a disposition on the part of the Board of Supervisors or Commissioners to economize. Unfortunately, many county commissioners can see only the engineer's salary to be paid twelve times a year and the inevitable result that there will be quite a decrease in the number of days they can legitimately demand pay for laying off and superintending the building or repair of roads in their respective districts. In other words, the engineer is a usurper, taking away the salary of those guardians of the people's right who are so anxious to save money for the people that they save $200 per month engineer's salary and spend $500 per month in doing it. So long as we elect officials because of their popularity rather than fitness, and pay them a mere pittance for their services, we may expect many of them to be incompetent and often dishonest. A striking case, and which I am sorry to say is typical in many sections of our country, came to my attention in Alabama. A foreman in the employ of a certain county was discharged by the commissioners of the district in which he had been working. The commissioner gave as a reason for discharge, that he himself could look after the teams and hands and thereby save the county several dollars a month. The foreman resented his being discharged and took upon himself the investigation of the commissioner's record. He found that on a certain day this commissioner drove seven miles to a small bridge where he then and there made a contract with a party to repair the bridge at a cost of $1.50. A few days later he went back to this bridge to inspect the work he had ordered done. The record of the Commissioners' Court showed that cost of repairing was $1.50 and cost of inspection two days at $3 to $6. Did this commissioner do a dishonest act? He certainly was entitled to pay for at least the time consumed by himself yet it is manifestly wrong for such a condition to exist that cost of supervision is four times that of construction or repair. This would have been a very small matter to an engineer who, while having the bridge repaired, would attend to many other duties.

It is almost impossible to convince many county officials that an engineer can easily save his salary several times over by making certain changes in location and grade and by economically administering the affairs of the county. As a general rule a county gets more in return for money spent for engineering services than for any other single item connected with road construction. A good engineer is a dividend producer for a county. In speaking along this line at the

American Road Congress held in Atlantic City in 1912, Col. W. D. Sohier said:

> You will find if you look at any private corporation, that the ordinary engineering expenses for any work of the character of road building, any constructional work, is usually about 10 per cent, and that it is good money well spent.

Someone has said that an engineer is a man who can do as much with one dollar as a fool can with two. Evidently he did not have reference to the fool engineer.

The most expensive fool is the fool engineer. He is to a very great extent responsible for the prejudice many have against engineering supervision of road construction. There is absolutely no excuse for a county employing an incompetent man, now that the government, through the office of public roads, stands ready and anxious to aid any county in securing a good engineer. An engineer applying for a position should be endorsed by those for whom he has worked and by men competent to pass judgment on engineering work. It is an easy matter for a man to get endorsements from friends who have perhaps known him in a social way, but such are only beneficial to prove his good character. An engineer with only a good character will build a road without any "character."

A highway engineer should have a good technical education and to be successful, he must be practical and he must be a diplomat. He should be sober, honest, energetic and think more about the work he is trying to do than the pay check he will receive at the end of the month. When taking charge of a county's road affairs he should convince the commissioners that he knows more than they do about building roads and then proceed to prove it by doing good work. Unless an engineer can absolutely convince his Board of Commissioners that he knows his business, he had best resign. Trouble is often brought about by the engineer failing to have a thorough understanding as to his duties. This can easily be avoided if, when an engineer makes a contract with a county, he clearly sets forth in this contract what his duties are. If he is to be held responsible, and he should be, for the success of the undertaking, he should have full power to employ and discharge those under him. I think this is well expressed in Rule 2 of Rules and Regulations of the State Highway Department of Alabama, which reads as follows:

> The functions of the Commission are judicial and those of the engineer, executive. The engineer will receive and carry out the directions of the Commission and shall, in turn, direct those under him. The engineer shall have full charge of construction work, directing it in all its details. Any orders the Commission wish to give an employe shall be given through the engineer, and the engineer shall have the right to employ, with the consent of the Commission, and to suspend, subject to discharge, without consulting the Commission. All suspensions shall be reported to the Commission for such action as they deem necessary.

In conclusion, let me say to you who are commissioned to spend the people's money, if you are in doubt as to the advisability of

employing an engineer, observe closely the roads of a county built without the guiding hand of an engineer and then those of another that have been built by a man skilled in highway engineering. Don't employ a man whose only qualification is that he is cheap. His salary will be small and his mistakes will be many and expensive.

When you are sick you call the doctor,
When you are mad you call the lawyer,
When you are hungry you call the baker,
When you are broke you call the banker,
When you are in trouble you call the preacher,
When you are ignorant you call the teacher,
When you want cotton you call the farmer,

Then, when you are in need of good roads, why don't you call the engineer, that good roads physician who will heal the wounds of the country roads, who will operate upon their surfaces and place them in perfect order.

In conclusion, permit me to say, I have no ill-will or animosity for any road official. I have tried to point out some of their false ideas and mistakes and offered, as best I could, a remedy.

MR. JACKSON: After hearing the address of Mr. Keller, of Alabama I wish to make a few remarks. I happen to be a county commissioner and naturally paid some attention to the remarks of my friend from Alabama. I fully agree with Mr. Keller on one point and that is the necessity of engineers supervising the work in the various counties. I think that I can prove my statement by the past record of the county commissioners in the county which I have the honor to represent, Hillsborough in South Florida, because when we voted a bond issue of a million dollars, more than a year ago, we sought a competent engineer at a salary of $5,000 a year; that in itself is proof that I agree with Mr. Keller on the necessity for engineers. In addition we have an engineer employed for our regular county work and have had for some years past, at from $1200 to $1800 a year, and I don't want this Congress to think that all the county commissioners of these Southern States are prejudiced against engineers.

THE CHAIRMAN: Mr. Robert C. Terrell, State Highway Commissioner of Kentucky, will open the discussion on Mr. Keller's paper.

MR. TERRELL: In discussing Mr. Keller's paper on "Engineering Supervision of Road Construction," I have no criticism to make, and wish to commend the statements that he has made.

In general, however, I wish to call attention to, and emphasize the fact, that not only in the State of Georgia, but in every other Southern State "the marks of the commissioner (or member of the fiscal court) who saves his county the salary of an engineer and spends it thrice over in useless work and expensive maintenance" this

is true; and where the services of an engineer have been omitted, the roads in general follow the old pack-horse trails, which in turn followed the foot-paths of the Indian who climbed from the top of one high hill to the top of the next on the shortest and most direct route and in order to attain the highest point from which to search the surrounding country for the herds of buffalo, deer and elk and in order to be on the lookout for the enemy.

Roads constructed along these lines are unnecessarily steep, hard to construct, and ten times over, harder to maintain, than those which are laid out by the engineer. In the State of Kentucky there are splendid examples of the difference between roads thus built and those built by engineer; for as early as 1830 the State began the construction of roads under the supervision of competent engineers, the director of this engineering force being a Frenchman who was thoroughly familiar with the methods of location and construction used in France at that time. Roads laid out under the engineers during that period still show marked evidences of the skill of the engineer in the easy grades, easy curves, good drainage, wide roadbeds and types of construction. In the many miles of road which were constructed during that period at which interval improvement had its being and reached its zenith in the Southern States are monuments to the progressive and intelligent ideas that were then prevalent among our political and economic leaders.

These roads in many instances were cut from solid rock in order to secure proper grades and alignment, and massive stone walls were built where necessary, but with the backward swing of the pendulum followed by the calamities of the Civil War, the wheels of progress stood still, not only in commercial and financial lines but also in road building and engineering supervision as well. Since that time, however, little progress has been made, although many miles of roads have been surfaced with stone or gravel, at possibly much lower first cost than were the roads previously mentioned; yet the maintenance (or possibly better put, the necessity for completely resurfacing the roads) has made them much more costly; yea, thrice over more costly than the original cost, and the maintenance of roads built under engineering supervision many years before.

The Southern States have probably suffered most from the lack of engineering supervision on road construction due to the reason given above. After the close of the Civil War, the commissioners (or magistrates) felt it their duty to save the salary of an engineer and to surface as cheaply as possible the largest number of miles of road, believing that a road surfaced with stone or gravel would last indefinitely; paying no heed to grades or drainage and basing their calculations upon the results of roads built by engineers in an earlier day who had given special attention to the points entirely overlooked by the commissioner or magistrate. Little did he dream that his penny-wise policy was costing his county pounds; yea, many thousands of pounds annually.

No pendulum ever swings so far, however, but that it must swing back again; and in 1912 the State of Kentucky saw the dawn of a new era in road building when the State again provided for engineering advice on the construction and reconstruction of the public roads and bridges; and still more definite steps were taken by the 1914 General Assembly in the passage of additional laws designating a system of State highways and providing for State aid for their construction and engineering supervision on all work to which State aid was granted. Already the fiscal court, or board of magistrates, of the various counties are seeking to take advantage of the State aid engineering advice and supervision, and are beginning to realize more fully every day the advantages of building with a view of not only caring for the present, but looking to the future development of the country and the travel that the road will be expected to carry by constructing or reconstructing their roads in such a manner as to care for the traffic of the future as well as the present.

Mr. Keller's paper has brought out well the advantages to be gained by having engineers take up the estimates, look after the purchase of materials and see that the unit costs are kept, and that the prices paid are correspondingly low. The material salesman has found that for the official who is not skilled in the purchasing of such material is prone to reject the advice and information furnished by engineers, or rather resent the idea of consulting an engineer; that to this type of man he needs only to pat him on the back, flatter him on his judgment and business ability and secure the contract at an advanced price, and in many instances, at a sufficient price to enable him to induce his competitors by one means or another not to interfere.

To this type of official, the material dealer finds the flattering tongue for the commissioner (or magistrate) and a denouncing tongue for the engineer very profitable and effective, as the engineer as a rule refuses to stoop to heated arguments or personalities with the dealer. However, this tendency toward the electing of more competent officials who are more conscientious, intelligent and business-like, is the rule rather than the exception, and with the upward trend comes the recognition of the engineer and his value in the supervision and road construction.

I have endeavored to point out only a few advantages of engineering supervision which are apparent in my native State, and in closing I wish to say that I do not feel that I can add very much to Mr. Keller's splendid paper. I wish to heartily endorse in general the statements he has made.

THE CHAIRMAN: The next paper is "State Control of Road Work as a Policy," by Mr. A. N. Johnson, of the Bureau of Municipal Research, New York City.

STATE CONTROL OF ROAD CONSTRUCTION

By A. N. Johnson

Bureau of Municipal Research, New York

The control by the State of road construction has grown from zero in 1893 to a widespread policy among the States, varying much in degree and method of application; from extensive control extending even to supervision over the smaller political units, to concern only with a few highways in whose construction the State is directly financially interested. Between such wide limits there exist almost all degrees of State interest.

Before entering upon any discussion as to the merits of the policy of State control of highway construction, it is perhaps well to make a brief summary of existing conditions. For this purpose a study has been made of the road laws, advantage being taken of summarized statements where they existed or were at hand for consultation. It may, therefore, happen that in some details of the table herewith presented there may be some slight error, due to the interpretation from the road law itself to the summary, and also the interpretation placed upon the summary. However, as the purpose of this table is merely to give a general view of conditions which would not, therefore, be seriously modified by any slight error, it was not thought of sufficient importance to take the large amount of time that would have been necessary to check carefully this table against the text of the road laws themselves. In the main it is believed to be accurate and for the purpose devised, trustworthy. Some analysis and explanation of the table will aid in its interpretation.

The States have first been checked in regard to the existance of a State highway department. Checks have been made in divisions under this general heading showing whether a State has highway commissioners and a State engineer, or both. Under the heading "commissioners" the States have been checked to show whether the commissioners are appointed or elected, whether any qualification is required, whether any members of the commission are ex officio members. Under the State engineer it is noted whether he is an appointive or an elective officer and whether any qualification is required.

The next main division is State aid roads. By State-aid roads is meant specific sections of roads for which the State pays some portion of the cost, and exercises direct supervision in their construction, as contrasted to a few instances where the State pays the towns certain money to assist in the construction of their roads in general. Under State-aid roads it is noted whether the construction is controlled by the State, and whether maintained by the State or by local authorities. Also, whether they are paid for entirely by the State, by the State and county, by the State, county and town, and whether the land owners of abutting property pay any portion of the cost. The

STATE CONTROL OF ROADS

STATE	STATE HIGHWAY DEPT: COMMISSIONERS: APPOINTED	COMMISSIONERS: ELECTED	COMMISSIONERS: EX OFFICIO	COMMISSIONERS: DIVISION OF TRANSPORTATION	STATE ENGINEER: APPOINTED	STATE ENGINEER: ELECTED	STATE ENGINEER: EX OFFICIO	STATE AID ROADS: CONSTRUCTED BY CONTRACT	STATE AID ROADS: CONSTRUCTED BY STATE FORCE	STATE AID ROADS: CONSTRUCTED BY STATE AND COUNTY FORCE	STATE AID ROADS: CONSTRUCTED BY LOCAL FORCE	STATE AID ROADS: PAID FOR: STATE	STATE AID ROADS: PAID FOR: STATE AND COUNTY	STATE AID ROADS: PAID FOR: STATE AND LOCAL	STATE AID ROADS: PAID FOR: COUNTY	STATE AID ROADS: PAID FOR: LOCAL	OTHER ROADS: CONTROL: BY STATE	OTHER ROADS: CONTROL: BY COUNTY	OTHER ROADS: CONTROL: BY TOWN	OTHER ROADS: LOCAL ENGINEERS REQUIRED BY LAW: APPOINTED BY: GOVERNOR	OTHER ROADS: LOCAL ENGINEERS REQUIRED BY LAW: APPOINTED BY: STATE HIGHWAY DEPT	OTHER ROADS: LOCAL ENGINEERS REQUIRED BY LAW: APPOINTED BY: COUNTY BOARD	OTHER ROADS: LOCAL ENGINEERS REQUIRED BY LAW: APPOINTED BY: LOCAL BOARD	OTHER ROADS: CONTROLLED BY: COUNTY	OTHER ROADS: CONTROLLED BY: TOWN	OTHER ROADS: PAID FROM: COUNTY FUNDS	OTHER ROADS: PAID FROM: SPECIAL DISTRICT	OTHER ROADS: PAID FROM: TOWN FUNDS	OTHER ROADS: PAID FROM: ABUTTING LAND OWNERS	REMARKS
ALABAMA	1			1	1			1					1				1								1				
ARIZONA	1				1		1	1									1								1				
ARKANSAS	1				1												1								1				
CALIFORNIA	1			1					1			1					1								1				
COLORADO	1		1					1		1			1				1								1				
CONNECTICUT	1							1	1			1	1				1			1									
DELAWARE	1							1					1						1		1			1					
FLORIDA																		1											
GEORGIA																		1											
IDAHO	1			1	1			1	1				1					1		1			1		1				
ILLINOIS	1				1		1	1	1				1				1								1				* Plans prepared by counties
INDIANA																		1							1				
IOWA	1			1	1													1		1					1				
KANSAS					1													1							1				
KENTUCKY	1		1														1				1				1				
LOUISIANA	1				1		1	1	1				1					1		1					1				
MAINE	1		1		1			1	1			1	1					1							1				
MARYLAND	1		1		1			1	1			1	1					1							1				
MASSACHUSETTS	1				1			1	1			1	1	1				1							1				
MICHIGAN		1						1					1					1							1				
MINNESOTA	1				1		1	1		1			1					1							1				
MISSISSIPPI																		1							1				
MISSOURI					1		1	1		1						1		1							1				
MONTANA	1		1	1	1			1		1			1					1							1				
NEBRASKA					1													1							1				
NEVADA					1			1					1					1							1				Convict labor only
NEW HAMPSHIRE	1				1			1	1				1					1							1				
NEW JERSEY	1			1	1			1	1	1			1					1							1				
NEW MEXICO				1	1			1	1				1					1							1				
NEW YORK	1							1	1				1					1							1				
NORTH CAROLINA	1				1			1					1					1							1				* Convict aid only
NORTH DAKOTA	1			1	1													1							1				* Advisable but provided by county
OHIO	1				1			1	1				1					1							1				County engineer elected
OKLAHOMA	1		1		1													1							1				
OREGON				1	1			1	1			1						1							1				
PENNSYLVANIA	1				1			1	1			1	1					1							1				
RHODE ISLAND	1							1	1			1						1							1				
SOUTH CAROLINA													1					1							1				
SOUTH DAKOTA	1							1										1							1				
TENNESSEE																		1							1				
TEXAS																		1							1				
UTAH				1	1			1					1					1							1				
VERMONT	1							1	1					1				1							1				
VIRGINIA	1		1					1	1				1					1							1				
WASHINGTON	1			1				1	1	1			1					1							1				* County engineer elected
WEST VIRGINIA	1			1				1		1			1					1				1			1				Still may furnish road, drag, etc.
WISCONSIN	1			1	1			1	1				1					1			1				1				
WYOMING					1			1	1			1						1							1				
TOTAL	31	1	7	14	27		6	34	21	7	15	26	2	2	24	3	17	16		5	2	10	39		6				

relation of the State to other than State-aid roads is shown by the control exercised by the State, whether advisory or specific, that is, the State exercising by law definite supervision or whether the roads are entirely under local officials' control. The existance of local highway engineers is also noted, whether they are appointed by the local authorities or by the State department, and whether there is any qualification required on the part of the State; again whether their actions are controlled in any way by the State or are under the control of local officials only.

The source of money expended upon the roads is noted, whether from county or township taxes, whether, where townships exist, there is any provision for county aid to the townships; also whether local communities receive any aid from the State to assist in the maintenance and construction of their local roads in general.

Some of the facts to be noted from this table are: that there are but seven States without State highway departments. There have thus been created in the past twenty years thirty-six State highway departments. Of these thirty-six States it is to be noted that thirty-four have State-aid roads, that is, specific pieces of road which are constructed in part by State funds; five of the State highway departments have no commissioners, only a State engineer; while fifteen have State commissioners and no State engineer. It is thus seen that a majority of State highway departments are organized with a commission and State engineer.

The State highway commissions are appointed in part or in whole in thirty-one States, while in fourteen the State highway commissions include ex officio members. In but one State is the highway commissioner elected, and in seven only are any qualifications required. In twenty-seven the State engineer is an appointive officer. In no State is he an elective officer, but in six only are qualifications required. Where any qualifications are required for the position of State engineer they are for the most part among the recently enacted State highway laws. State highway legislation could be much bettered, if qualifications were required in all the States where State engineers exist but it is at least some satisfaction that the State highway engineer is in no State an elective officer.

In the States where State-aid roads are built, it is to be noted that the construction is controlled by the State in thirty-four instances. In twenty-one instances the State-aid roads are maintained by the State, that is, the State exercises immediate supervision and control of the maintenance, although the expense of the maintenance may not be in each instance fully at the cost of the State. In the remaining instances the control of the maintenance is in the hands of local officials. As it was a number of years before any State save Massachusetts exercised control over the maintenance of the State-aid roads, the large proportion that now do take charge of this important function shows a greater realization of the importance of maintenance of the State-aid roads by a central control, and where States

are contributing funds towards any considerable mileage, they must soon realize the absolute necessity of State control of the maintenance of these roads if the service that State-aid roads should render the public is to be secured and the investment made by the State in their construction conserved.

The method of paying for State-aid roads varies in different States, and it varies for different roads in the same State. Some States, for example, have a certain system of highways for which the State pays all the cost, while on another system of roads the State and county divide the cost. There are fifteen States in which the State pays the total cost on State-aid roads, although some of these States also share with the county or town in the construction of other State-aid roads. There are twenty-six States in which State-aid roads are built by the aid of the State and county, two in which the State and town are contributors; also but two in which any assessment of the cost of the State-aid road is borne by the adjoining property. It is thus seen that most States consider that State-aid roads should not be paid for by assessments on adjoining property.

The control by the State over other than State-aid roads has been a recent development and its origin may probably be traced directly to those States which began their State road work by the organization of a commission to study and report on conditions before undertaking definite expenditures for State-aid roads. This was first undertaken in Maryland, and the law provided that the State could advise with local authorities as to the construction of their roads and bridges, and the work of the Maryland highway department demonstrated that there was much to be gained by advisory supervision on the part of the State. Such work has been done by a number of States only to a greater degree, notably, in Illinois, Wisconsin and Iowa. The work in these States at first was advisory only, that is, the local authorities coöperated with the State departments voluntarily, the law not requiring that they should necessarily follow the advice given by the State. But the remarkable success of this work, the widespread influence it exerted after a few years of activity, the hearty coöperation on the part of many local officials, and compulsory coöperation through public opinion on the part of others, demonstrated conclusively the wisdom and the need for definite control by a State highway department over the activities of local road officials.

Today advisory control is exercised by State departments in twenty-three States and definite control already exists in three.

Perhaps the greatest significance attaches to the fact that there are fifteen States in which local highway engineers are provided for by statutes. This is in considerable contrast to the opinion that road work could be done by anybody and did not require any skilled supervision. But the fact that in no more than a third of the States are local engineers required by statute shows that the appreciation of skilled control has not spread to the extent that it should. The work that has been accomplished by the highway engineers in the

past ten years in this country has demonstrated beyond further argument the need for such control.

The reason for a policy of State control of road work that exists in so many States, and is increasing, will be found in the demand of the people generally in all parts of the country for better highway service. Highway transportation has become an increasing factor in economic development, and with its increasing importance there is demanded better transportation facilities of the highways. This necessitated that the highways should be given better attention and different treatment than had been the practice. The problem of highway development is realized to be of general concern, not merely local. The interests of one locality in this problem is no longer confined to the roads immediately adjoining, with the result that it has been manifest that a larger unit of control than a town or county would be necessary if the development of the highways was to be such as would make it possible for them to render the service the public demands. There has, therefore, grown, as we have seen, an increasing control by the State over the local communities in the matter of road building, and as a broad policy, resting as it does on sound economic conditions, it is not only wise, but inevitable; and that it is practical has already been demonstrated by the work done in many States. Among these may be mentioned notably Massachusetts, Connecticut, New York, Illinois, Wisconsin and Iowa.

Perhaps the most interesting study of State control is to be had from an examination of the Iowa law and its practical application. In Iowa the State highway department spends no money on State-aid roads but it is concerned solely with the direction and supervision of the taxes raised by the local communities for expenditure upon their highways.[1]

The work done in many States, particularly in Illinois, has demonstrated the efficiency of road construction by day labor. As carried on in Illinois, the State furnished the skilled supervision and the more expensive machinery, the locality, the labor and teams. There is a two-fold benefit gained by handling the work in this manner—the quality of the work is superior to contract work, or perhaps, a fairer statement would be, the quality of the work desired is more readily obtained, and is done at a cost to the community less than it could be done by contract. Where State control of road work exists and extends into the concerns of the smaller units, it is possible for a much greater variety and amount of work to be handled by day labor, than would be at all wise or practicable if the skilled supervision that the State highway department can furnish the localities could not be obtained.

What has been realized from State control of road work may be

[1]For more detailed examples and accomplishment through the policy of State control of road work, the reader is referred to the paper prepared by Mr. Thomas H. McDonald, State Highway Engineer of Iowa, to whom is due chief credit for the splendid results that have been attained in that State.

thus summed up: The development of a system of main highways adapted to modern motor freight traffic which promises such great economic changes in both rural and urban life, increasing the efficiency of local road officials in the expenditure of the local taxes by preventing useless undertakings, by suggesting economic forms of construction and by increasing the economic service of the highways by concentrating expenditures on important roads and preventing waste on unimportant ones; the prevention of numerous accidents and fatalities by the construction of safe bridges and elimination or treatment of railroad grade crossings in such a manner as greatly to lessen the danger from them. And experience has demonstrated that these ends are accomplished by State control of road work and only by such control.

THE CHAIRMAN: Next on the program is the discussion of Mr. Johnson's paper, by T. H. MacDonald, State Highway Engineer of Iowa, which will be read by Mr. H. C. Beard, member of the Iowa Highway Commission.

MR. BEARD: *Mr. Chairman and Gentlemen of the Congress:* This paper was prepared by Mr. MacDonald, our highway engineer, who is unable to attend this meeting and I will read it. I will also say, while I do so, that at one place in this paper, I wish to enlarge a little bit upon it relative to the organization that we have completed under the law as laid out here. State control with State aid, as pointed out by Mr. Johnson, is written into all of the older State laws which established and placed in authority, State Highway Departments. State control without State aid is a new principle in such legislation because of the long association of these two ideas, they have become confused in the popular mind so that State control has come to mean State aid, and if a State proposes to exercise certain control without paying for the privilege by the appropriations of funds to the local communities the State immediately encounters more or less hostility from these communities. The more or less is dependent upon the number of local patriots who are willing to sacrifice their own personal interests on the altar of public service, i.e., in some office within the gift of the voters. Seriously, however, the principle of State control is quite separate and distinct from that of State aid appropriations, and these are not necessarily complementary State policies. State aid may be appropriated from State revenues received from sources which do not contribute to local taxes or it may consist in a distribution of State tax receipts on property which also pays local taxes. If the former, then State control with State aid is a justifiable policy only if this control secures equal or greater returns to the State than if such aid were distributed without State control. If the State aid funds are simply the distribution of direct property taxes, then State control must justify itself by better results than if the same amount were ex-

pended as local taxes. As shown in the preceding paper all of the thirty-four States which have State aid roads, exercise State control over the construction and twenty-one States have found it necessary to take over the control of the maintenance. It seems to be a thoroughly established fact that the State must control the maintenance of State built roads if these are to be maintained adequately and continuously. This fact is proof positive that State aid is something more than the appropriation of money, and that it contributes an element of administrative efficiency that is not in any way measured by the amount of funds appropriated. If this be true, then in this fact we find a justification of State control without State aid. From a study of the policies of the method of extending State aid as set forth, each method is a product of the method of raising State revenues, the state of development of road construction reached, the area or mileage which the plan is adopted to cover and the particular type of administrative scheme adopted. The older State laws in force in the Eastern States show the influence of the French and other foreign administrative plans. These methods as they have been adopted by States further west, have been changed or modified by the above factors. The more recently adopted measures in the upper Mississippi Valley States have shown a considerable divergence from the older plans. As stated by Mr. Johnson, these plans were adopted generally after some years of operation of a commission or State Highway Department having advisory powers. The work of these departments greatly demonstrated the desirability of a more efficient use of the funds available and the possibility of greater results with such an administration than through increased appropriations without an efficient administrative system. Of the highway laws that have been passed in recent years, the Iowa law probably contains more distinctive departures from what might be termed established practice than any other law. The less than two years in which this law has been in operation is far too short a time to judge of the measure as a practical working policy. That it is not yet a finished or polished administrative measure will be admitted by any of its warmest friends, but even its enemies must admit that the change in the road situation in the State, speaking from the balance sheets which show the results accomplished, are surprising. Those competent to judge expected that it would take five years to bring such a measure into a satisfactorily working system, but in many of the counties practically the first year's work has shown the law enforced almost to the letter so far as the county work is concerned, and in these a considerable portion of the townships are operating in full accord with its provisions. The smoothness with which the system has been working in many of the counties has astonished those who expected several years of general opposition to a policy of State control without State aid. In formulating this law, which is taken as a typical example of a law formed to supply State control without State aid, the General

Assembly of Iowa disregarded practically all measures relating to roads and bridges then on the statute books, excepting those relating to revenues alone. An entirely new road measure was drafted without changing the revenues that could be raised for road and bridge purposes. One fund was made a mandatory levy in place of an optional one, which is absolutely the only change in revenues made. It is true that a somewhat larger sum has been raised for road and bridge purposes the past year than during previous years, but this has been due principally to increased valuations, and the per cent of increase is not large. We have then the situation of a measure providing State control over local administrative units under an entirely new system without a material change in the revenues. If under such a system results greater than under the old system are secured the policy of State control must be given the major share of the credit, as it will not be due to increased local revenues, and there is no State aid fund. Briefly the plan of organization is as follows: each township is controlled by a board of trustees which has power to levy taxes for township road purposes and appoint one man who is responsible for maintenance of township roads. In each average Iowa county there are sixteen townships. I wish to add here that those township men appointed by the board are non-experts, they have no engineering ability and receive not more than $4.50 a day for their services. They nominate superintendents and supervise the work in areas about 6 miles square and expending only under their direction from $600 to $2000 per annum. Each county is governed by a board of three to seven supervisors who must appoint a county engineer or engineers, and who have the sole authority to levy the taxes for county roads and for building all culverts and all bridges, on both the county and the township roads. The State Highway Department is a board of three men, two appointed by the Governor and one ex-officio. These men have authority to appoint an engineering corps and office assistants. Under this provision of the law we have 13 or 14 engineers working all the time under the direction of the Highway Commission. The three members of the commission have devoted a great deal more of their time than the law contemplated that they should to putting into effect this law. They limited us to pay for only 100 days in the year. I worked 160 days myself and the other members of the commission appointed by the Governor, who is the owner of several hundred acres of Green County land, worked over 200 days and the chairman of our commission who is Dean of Engineering in the Iowa State College worked perhaps 150 days in putting this law into effect the first year. We have now under the direction of our field engineer and our highway engineers 6 district engineers who have the State under their immediate control for the direction of road work. We have the State divided into 5 districts and a man in each district to supervise and direct the work of the county engineers, and in addition to that we have one man who is a district engineer at

large, practically, although he will be assigned a district soon. We have another engineer who puts in all his time at the work of making surveys and plans for the elimination of dangers at grade, undergrade and overgrade railroad crossings. The county engineers are appointed by the board of supervisors, but are liable to removal by the highway commissioner for any cause that the highway commissioner may deem proper. Up to this time we have removed about 20 county engineers. At the beginning we found an inclination on the part of supervisors to honor the memory of a lot of county surveyors by making them county engineers. A number of these men had to be removed. Several others accepted the suggestion that it was nearly time to resign, and now we have county engineers, one at least in each county and in some counties two, who are more or less competent although there are removal proceedings pending against perhaps a dozen or more at this time which will probably come to a termination against the county engineers before the first of the year or before the work begins next year. The Iowa law does not provide for any merit system in the selection of highway engineers or the county engineers but we have put into effect such a principle in a merit system of our own since the beginning. We were accused when we started out of being engaged in the occupation of creating offices, soft snaps they were called and considered—for the graduates of the Iowa State College —but the fact of our year and a half's work disproved that charge. We now have in our force a number of men, I am not able to tell exactly the number, who are not graduates of any college, or university within the State, and many more who are not from the institution with which our highway commission is connected by being located in one of the buildings and having the Dean as chairman of the commission. The county engineers have been drawn from all parts of the country. We took the county engineer of Buchanan County, Missouri, for one of our county engineers and we had thrust upon us the assistant engineer of the State of Nebraska as the county engineer and there are engineers at work in the State from all parts of the country. We got most of our efficient engineers from the railroad companies. At this time the railroad companies in our State are letting out their engineers and we have possibly 25 engineers that have come to us within the last year from the railroad companies. Those men are almost always proven to be very efficient in the work that is put under their charge. The plan of operation is as follows: All roads are divided into two classes. The county roads which are the main traveled roads, constitute a definite system in each county of not more than 15 per cent of the mileage and these county systems are interconnecting at the borders with the other county systems so that a county system of 16,000 miles of interconnected highways constitute a primary or county highway system. Being continuous as they are through the counties the county systems form one great State system reaching every trading point in the whole State. These roads were selected pri-

marily by the board of supervisors of each county, but the commission was charged to the duty of receiving all protests, and of finally passing upon each system to make a continuous State system. About two miles of road were petitioned for, for each one mile that could be established. The system thus established constitutes a definite mileage that must be improved by the county before any change may be made or new roads added to the system. The remaining roads are placed in the local or township systems. Each local system is under the direction of the board of trustees and the township road superintendent, who is charged with certain definite duties among which is the continuous dragging of the roads, for which a non-divertible drag fund is levied by the townships. It might be interesting to many of you to know that under this division of county and township systems, that in some of the counties where the supervisors, backed by a certain per cent of public sentiment, have resisted the operation of this law, the townships have gone ahead under the law and done better than the counties have been able to do in the building and maintaining of better roads. The township trustees, in many instances, have shown the county boards the better way of building roads in the townships in the same county where the board of supervisors was resisting the new law. All bridges and all culverts on both systems are built by the board of supervisors. The State Highway Commission has general supervisory powers over both county and township boards, with power to enforce provisions of the law. All officials from the State highway commissioners to the local road superintendents are bonded officers, and responsible under these bonds for the performance of their duty. The whole frame work of the law is founded upon one general principle, that is the fixing of responsibility for each and every bit of work that is to be done in the construction and maintenance of adequate primary and secondary highway systems. Without going into the details of the operations and considering the fact that the law has only been in operation for one year, and that many problems must be met in the future in an administrative scheme that reaches down to the most unimportant road official, the following is a summary of the results which are being accomplished under the policy of State control without State aid:

First: Each mile of road, each culvert and each bridge is under the immediate supervision of some one man who is responsible on his bond for the proper condition of that particular item. If this official fails to perform his duties an appeal may be taken to the Highway Commission, which has full power and authority to enforce the provisions of the law.

Second: The road work has all been divided into certain definite classes and plans have been standardized for each class of work throughout the ninety-nine counties. For example, the profiles and sections for permanent road grading are made up in exactly the same form in each of the ninety-nine counties.

Third: Every piece of permanent road work is approved by the district engineers of the Highway Commission so that the same sections, maximum grades and finished product are secured so far as the topographical formation of the counties will permit.

Fourth: Culvert and bridge plans have been standardized. Standard plans and specifications are supplied to all of the counties by the commission. The adoption of uniform standardized plans is resulting in a more satisfactory class of work at lower prices.

Fifth: The system is predicated upon the appointment of a capable county engineer. The commission has the power of removal if the engineer fails to carry on his work efficiently. Already there have been changes in a number of counties in the interests of efficiency. This means that eventually there will be a strong class of county engineers who have broad constructive duties to perform.

Sixth: A uniform system of records and cost keeping and blanks have been supplied by the commission to all of the counties and townships, and each year a detailed report will be made by the county engineer of all the expenditures of road and bridge moneys in each county.

This law is essentially an earth road and permanent bridge measure. Within the funds available a large mileage of gravel surfaced roads can also be constructed. Some few stretches of the more permanent types will be built, but the system so far provides mainly for earth roads and permanent waterways. For a State such as Iowa, which has a fairly uniform distribution of population and in which the wealth is also quite equally distributed, there has suddenly come a demand for a large mileage of roads that will not only serve the market purposes but the intercounty needs as well. There are registered in the State over one hundred and ten thousand automobiles. This traffic alone has created a demand for and a sentiment in favor of improved roads, but the demand is for a large mileage rather than a small mileage of more permanent types of road surfaces. Under these conditions the policy of State control without State aid it is believed will secure these results quickly. Whether a policy of State aid is adopted or not, under the present system there is being built up an organization which will be capable of handling the more expensive types of road construction if the State concludes to establish the policy of State aid appropriations and appropriates large sums for permanent road construction. If this policy is not adopted, then permanent road construction will be developed in districts, and under this plan State control, issuing proper standards of materials and methods and efficient local engineering, will justify State control without State aid by the results obtained. [Applause.]

THE CHAIRMAN: The meeting will now adjourn until 10 o'clock tomorrow morning.

November 11, 10 a.m.

MR. JOSEPH W. HUNTER IN THE CHAIR

THE CHAIRMAN: The convention will please come to order. We will take up the program for the session. I want to say in this connection that I regret very much that Mr. Bigelow, State Highway Commissioner of Pennsylvania was unable to attend the session of the Congress. He has, however, sent me to represent him and in opening up this meeting I have a few remarks to make along the line of the subject that he was to take up, namely, construction and maintenance. I certainly appreciate the honor of having the privilege of being at this Congress and attending its sessions.

A twofold subject, any one part of which is a subject in itself, a proper treatment and presentation of which would require more than the allotted time for the presentation of such a paper.

First of all is the proper location of the road or highway that is to be improved, then comes the drainage and the proper construction of the subgrade or foundation. With these two requisites properly taken care of, the balance of the construction work is a matter of detail. Without proper drainage and the proper construction of the subgrade it is useless to construct or erect the road bed. Many contractors are beginning to realize that it pays them much better to give more attention to the proper drainage and construction of the subgrade of the road than to hurry through with this portion of the work than to have to go back and do the work over because of the failure of the metal and surfacing has been placed thereon. No building that is intended to be permanent will stand long on a poor or shaky foundation.

The work of maintenance is the larger and broader field, while the problems in construction are many, yet most of them have been, and others will be readily solved. But maintenance work is newer and the problems more varied, and on the whole of more importance; of course, much depends on the material used in the construction of the road, particularly in the surfacing. As eternal vigilance is the price of liberty, so is eternal vigilance or constant watchfulness necessary in the maintenance of any reconstructed or improved stone road. The historic stitch that saves nine means in road maintenance a shovel full of stones here, a shovel full of earth removed or placed, at the proper time, a ditch or culvert cleaned out or opened up. It costs less to properly and constantly maintain a road or highway than to neglect it, allowing it to become worn out and then resurfacing it.

The maintenance of the improved roads in Pennsylvania is being done by the State Highway Department with its own equipment and labor, at less cost than by any other method. The question of securing sufficient labor at the proper time has been a serious problem and will continue to be so until a sufficient number of laborers

can be employed continually. With such a body of trained men, better results can be obtained at less cost.

The maintenance of the 8000 miles of State highways, some of which are improved stone roads, but the majority of which are earth roads, is under the care of a maintenance engineer, and fifty superintendents; as is the maintenance of about 1500 miles of State aid roads.

In addition to the above work the State Highway Department was given by an act of assembly at the 1913 session, general supervision of upwards of 80,000 miles of earth roads. These roads are primarily under the care of three men, who are designated as a Board of Township Supervisors. These men are elected for a term of six years, one being elected every two years, this making a continuing board.

The writer was under the provision of the act appointed by the State Highway Commission to organize and take charge of the Bureau of Township Highways.

The first step taken was to get in touch with more than 4600 supervisors of the State by forming them into 66 county organizations under the provisions of an act of assembly which authorized the formation of such associations. Each association has its own officers, by-laws and rules which provide for one to four meetings per year.

At each of these meetings information was furnished to and instructions given to the supervisors, rules and regulations which the supervisors are required to observe were adopted, a uniform system of accounting established, all books and forms being furnished by the State; bulletins of instructions prepared and sent out, an engineering corps organized for the purpose of making surveys upon requests of townships that desired to change the grade of a road or to reconstruct an earth road as a stone, brick or bituminous road; also to stake out bridges, plans for which are made by the Bridge Department. Surveys, bridge plan and all work done for township is at the expense of the State. Upward of fifty road surveys have been made and two hundred and fifty bridge and culvert plans have been furnished in less than a year.

Upon compliance with the provisions of the law and with rules and regulations of the State Highway Department, each township is entitled to receive 50 per cent of the amount collected in cash, the work tax has been abolished, for the maintenance of the earth road, and in the maintenance of bridges, or in the reconstruction of earth roads as stone or brick or bituminous roads, or in the reconstruction of bridges, provided that the sum to be paid by the State shall not exceed $20 per mile.

The total amount collected and expended by the several townships in the State for the year 1913 as shown by the annual reports of the several Boards of Township Supervisors is $5,410,424.27. About 13 per cent of this amount was expended for collecting and

disbursing. The board of supervisors serve without compensation but are allowed their necessary expenses. Hereafter township supervisors must show that they have expended for some permanent improvement of their roads a sum equal in amount to the sum received from the State.

This hasty sketch has been given to show that Pennsylvania is now starting in the right direction to obtain the improvement of the earth roads in the State. Because of the information furnished and advice given a noticeable improvement has been made in many sections of the State. There has been some antagonism shown on the part of the few township supervisors, but the great majority of them are in favor of the changed method and new system.

Good township government is seldom obtained on purely party lines. Party politics should not be allowed to enter into the organization of any State, County or Township Highway Department. Get the best men possible from your home State, county or township if practicable, but get good practical men, no matter where they may come from.

While the Pennsylvania State Highway Department employees are not under civil service, yet it is the rule of the commissioner that the man who has shown proficiency is the man who is retained and promoted. More than a majority of the division engineers have been with the department for about nine years, some of them have been promoted to maintenance engineers. Assistants to division engineers have been made division engineers and their places filled by promoting transitmen, and so along the whole line. Of the fifty superintendents of State highways, but few are engineers. They were selected from among men who had been supervisors and from among others who had some practical knowledge of road work, some changes had to be made until the superintendents, as a whole, are a good practical lot of men. Many of the inspectors of construction work are others than engineers, in fact, some of them make better inspectors than the engineers, they being more practical and seem to use their common sense to better advantage. Anyhow, about 90 per cent of road work is common sense.

Much can be gained by having at least an annual meeting of all the men in the employ of a State Highway Department, a semi-annual meeting, perhaps would be better. It is coming together, the touching of elbows, the exchange of thoughts, the discussion of methods that make for the efficiency of the whole organization, and help many a timid fellow over a hard place. The old motto "In unity there is strength" still stands, and will for all times.

THE CHAIRMAN: The first paper on the program is "Rights of Way," by Austin B. Fletcher, State Highway Engineer of California. This paper will be read by Mr. Sohier, Chairman of the Massachusetts Highway Commission.

MR. SOHIER: I am so accustomed in Georgia to your not knowing who I am or quite who I represent that I feel perfectly at home in representing Mr. Fletcher of California, because he originally came from Massachusetts and served with me. He has a topic that will interest everybody who is interested in highways. Most of the subjects interest only a few; dirt roads, sand clay roads, macadam roads and various bituminous macadam roads and pavements only interest people who have money enough to build those kinds of pavements, and most of us in this country have to be satisfied for some years to come with the well maintained, well graded dirt roads, but the right of way is totally different. Men may come and men may go, but if the right of way is not sufficient for all future time, then you as the highway commissioners have been recreant in your duty.

RIGHTS OF WAY

BY AUSTIN B. FLETCHER
State Highway Engineer of California

Adequate "rights of way" of "locations" are of prime importance in any highway system and too little attention has been given to this feature of highway work hitherto.

In the mad haste to get the roads built so that the automobile enthusiasts may use them "while they are yet alive," we are prone to forget that the highway location is the one really permanent feature of the road work.

The time to secure proper locations for the roads, and widths sufficient to serve all purposes for long years to come, is NOW. If we wait until some future day to correct improper locations, and to secure suitable widths of rights of way when we have more leisure, we will have wasted much money in pavements constructed and the land needed will cost much more and will be more difficult to acquire.

It goes without saying that all land owners are more complacent in giving up portions of their property to the public before the improvements are begun than at any time afterward.

In some of the older States the people came long before "sectionalization" by the government was thought of but in the Middle West and on the Pacific Coast, most of the land was divided years ago "checkerboard" fashion by the government surveyors.

The highways in the older States were laid out, or in most cases, simply grew where the travel wanted to go but in the flat prairie land of the west, and even in the Pacific Coast valleys, the roads were often, if not generally, laid out straddling the section lines, the center of the right of way being usually coincident with the section line. This plan had the merit of lessening the area of land deducted for road purposes from the holding of an owner by making his adjoining neighbor provide one-half of the land required for the roadway.

This method of road location often proves to be an embarrass-

ment to the present-day road builder since this time-honored rectilinear scheme does not fit the present needs. Centers of population often times have not occurred in conformity to such a plan; often the railroads have determined the location of the towns. In such cases it is desirable, considering the volume of "through travel" in motor cars and trucks, to construct the roads in the most direct lines possible. This often entails rights of way running diagonally across the sections, "cuts up" land holdings and makes trouble generally for the right-of-way department.

But when the rectilinear plan has been carried still farther and the land owners, to conserve particularly good areas for agricultural purposes, have had in times past enough influence to cause the county authorities to discontinue or vacate portions of ways along the section lines and have introduced right angled turns into the half or even quarter section lines, then the engineer has a task worthy of his mettle to secure a proper location for his improved road.

And if the road be in an orange grove section, his joy is indeed complete.

The writer knows of a main paved road in one of the California counties which has at least ten right angled turns in it in a distance of about 20 miles and this road passes through no town or city and is practically level. In planning their new highway system several years ago, that county gave up as hopeless the task of securing a direct route in the locality referred to, so for many years to come all through travel over those 20 miles of beautifully paved highway must be subjected to the dangerous right angled turns and to the unnecessarily increased length.

There is reason in cities and other centers of population for ways laid out in rectilinear fashion. In the open country, there is no excuse for planning a new highway system along such lines. Land should be condemned if the owners will not donate it.

There should be as direct a line between important centers as the topographical conditions will permit.

Assuming that the best alignment for the highway has been adopted taking into consideration the factors of topography, climate and traffic needs, present and prospective, the next question confronting the highway engineer is the width of right of way.

It is certainly desirable that in any highway system the right of way be of uniform width but as a practical matter, each link in the system must be considered by itself. Near the centers of population it is obvious that the pavement and the rights of way must be wider than in remote rural communities, sparsely settled.

It is the writer's opinion, however, that for a minimum width of right of way 50 feet is none too much and that wherever possible, a width of 60 feet is the least that should be secured, even in sparsely settled localities.

It is inevitable that street railway, electric light and power, gas, telephone, and telegraph companies will at some time clamor for

locations in the highway, and although too little attention has thus far been paid to the matter, tree planting and other landscape treatment of our country highways will have to be provided for.

In many of the older sections of the country right of way problems are not serious affairs. Ways have been established there, well defined and traveled, for many years, and right of way improvements consist chiefly in rectifying the side lines of locations where abutting land owners have encroached successfully under the "open adverse possession" statutes which apply in some of the States.

But in many localities, the acquisition of necessary easements of way becomes as important a factor in the plan and progress of highway work as the road work itself.

In the more sparsely settled communities, roads have been built following lines of least resistance, in the valleys the "sectionalized" land lines, and in the hills wherever the ranchers could best spare it. Accordingly, when modern road building methods are invoked, it becomes necessary to alter meandering and precipitous roads by straightening, widening, and improving the gradients. The needed rights of way for these purposes must be acquired.

This feature of the work is particularly annoying to the highway engineer. His desire is to press forward the best line in the best way in the best time. When he is confronted by a hostile, reluctant or indifferent land owner, the engineer usually loses his patience.

It is not alone in cases of new rights of way that there is litigation, but frequently old surveys do not exactly coincide with existing ways, many of which in course of usage have become winding and irregular, and consequently additional land has to be acquired to widen, straighten or alter them.

Owners often build fences or cultivate up to the used portion of the ways and resist the shifting of the lines and delay the progress of the work. In many cases much time is lost where owners who have allowed people to pass and re-pass in vehicles without objection for years, assert adverse claims and work must be delayed to avoid complications.

One has also the experience of attempting to use dedicated rights of way shown on plats recorded in times past but which have been entirely unused or allowed to fall into disuse, and then being confronted by claimants, with their attorneys, who contest the rights of the public therein.

There are many unavoidable delays in obtaining rights of way, arising outside of the disputed rights of way mentioned. Even when the owners intend to be liberal they exact a great deal of information before signing the deeds of easement. The records have to be searched to ascertain the true owners of the lands affected; owners must be notified or corresponded with; draftsmen are asked to furnish sketches to many owners defining the rights of way desired; visits to the lands must be made and surveys inspected; minor adjustments of lines and fences must be settled upon; vacation pro-

ceedings arranged and prepared, abandoning the old roads or portions of roads over property so as to leave no incumbrance on the same when the new road is located and built; co-owners must consult among themselves before executing deeds of easement; ownerships involved in probate proceedings or title litigation must be searched and a good title to the roads acquired out of the confusion, and there are other details ad infinitum.

These many difficulties have led, in the writer's western experience in highway work, to the employment of the subtle right-of-way man, who needs be a psychologist as well as a philosopher. His chief duty consists in attempting to wheedle the often-times contrary land owners into signing the needed conveyances and to convince them, usually, that their duty to the public lies in giving their property gratis. Such an employee becomes a very important member of the organization. His troubles are many.

In addition to the "right-of-way man" and his assistants in the California work, the help and advice of an attorney learned in eminent domain practice has been had who devotes all of his time to the highway work and whose principal activities are in right of way matters. The writer takes this opportunity of acknowledging the assistance of Mr. Charles C. Carleton, attorney to the California highway commission, in the preparation of this paper.

In many jurisdictions, if the deeds cannot be acquired by diplomatic methods, war must be declared in the courts, and the highway board must desist from its efforts to promptly furnish the community with necessary thoroughfares until the courts finally determine that the litigious land owners' holdings may be entered upon.

There is a great lack of uniformity in the different States in the methods of paying or securing the payment of damages in taking property for public highway purposes. Such methods are of course regulated entirely by the constitutions and statutes of the respective commonwealths.

In some States it is not necessary for the authorities to pay for private property taken for public use in advance of the actual taking of possession. The property owner has been provided with a method of making his claim and with a tribunal constituted so that he may enforce his claim and obtain his damages therein.

In such jurisdictions, highway work may speedily progress and the laying out of routes followed by immediate construction. The property owner, if he is dissatisfied with the original offer of payment or the award made to him by the public authorities, may pursue his remedy in the appropriate court even though his land has already been occupied by the public.

The public has the advantage of celerity in the progress of its enterprise; the land owner is protected by ultimate and adequate compensation for his injuries, and in one State, at least, he may wait until after the State highway is completed before he must file

his petition for jury trial, it then being evident to all interested parties just what damage has been done, not only by reason of the land taken but by the road construction as well.

But some States are so unfortunate as to be harassed in their public work by constitutions and statutes expressly requiring prepayment before entry upon the land required for public use.

The writer has had to do with highway activities in two States which have operated under each of these methods, the one having the right to take land necessary for public use in advance of satisfying the owner; the other requiring that if the owner is not pleased with the offer made to him by the public authorities, he may stand back on his property with a shot gun and compel public officers to initiate proceedings in the court and remain off his property until after judgment has been obtained and the assessed damages paid into court for his use and benefit.

In the first mentioned commonwealth, the welfare and progress of the people as a whole are superior to the notions and eccentricities of an individual land owner.

In the other State, the recalcitrant land owner may oppose and delay the vital needs of a city, county or State, as the case may be, and his immediate rights predominate over the requirements of the community at large.

No rights of way, in States having regulations similar to the latter, can arbitrarily be taken by the people before the same, after a vast amount of red tape, have been acquired by donation, purchase or condemnation; that is, a taking cannot be made and compensation and damages adjusted afterwards.

Consequently obstinate land owners are able to "hold up" the community at large until it either pays the demands or contests the question of compensation and damages in trials, the latter usually requiring considerable time, particularly in the case of the belligerent or indifferent land owners residing in other States or foreign countries when long publications of summons are necessary before the suits may be commenced. The western States appear to be particularly oppressed by such roundabout methods of entering upon private property and installing improvements for the benefit and welfare of millions of people.

For illustration, under such a system a large western land owner owning an area equal in size to an entire eastern State may be luxuriously traveling abroad. A county has voted and issued bonds for a large amount to construct important highways. Before the great ranch can be entered upon, except for surveys, a correspondence must ensue between the public authorities and the land magnate. The owner declines to sign a conveyance and the people are compelled to commence proceedings in eminent domain against the absent owner. Before a trial can be had, summons must be published for sixty days, and then follow the tedious court proceedings.

It usually happens that pugnacious land owners demand some

exorbitant sum. The court may upon trial only allow a small percentage of their original claim but during the pendency of the action an important artery of travel may be debarred.

Such a system is absolutely hostile to progress; the people should be greater than the individual.

The writer submits that at this time, when modern highway construction is becoming so active throughout the nation, it is apparent that there should be simplification in the constitutions and statutes relating to the subject of eminent domain, and that this Congress may render invaluable service in assisting to bring about so desirable a result.

Too much attention can be given to the title technicalities of right of way activities. It has been an almost universal practice for public boards performing road work to obtain at great expense exhaustive abstracts of title to ascertain land ownerships.

The writer has had under his supervision the acquisition of hundreds of miles of highway right of way in California where the securing of rights of way could not be made much more difficult, complex or annoying, yet the purchase of expensive abstracts of title has been dispensed with. Out of hundreds of ownerships affected, not one serious complication has resulted from the following plan:

When the field parties are making the original surveys, the chiefs of party usually inquire from the occupants of the land surveyed who the owners or those interested in the property may be. This gives a clue to the ownership. Thereafter, one of the staff visits the proper county offices and ascertains from the assessment rolls or the records who purport to be the owners. Deeds or agreements are then prepared, containing the proper descriptions, and it is very rare, indeed, that any objection has been made to the accuracy of the instrument submitted.

By thus performing its own title searches, even though they may not have always been the most exact from a title lawyer's standpoint, the authorities have saved thousands of dollars and have never had an injunction or ejectment proceeding instituted against them by objecting land owners.

By taking a few remote chances of complaints, work, which would otherwise be hopelessly harassed and delayed in the performance of a highway project, may proceed.

Furthermore, in most States, title may be obtained two ways by user or implied dedication by the passage of time. It has been the custom in California where the present traveled roads are wide enough for use and properly located, to place the monuments and build the pavements and assert jurisdiction thereover, the theory being that if the owner objects, the authority's title being fundamentally weak, the State can "condemn" as rapidly as the alleged owner can "oust."

The so-called State highways in the several States may be divided into at least two classes with regard to the control by the State of

the roads after they are built, namely, those which are maintained by the State and over which the State assumes complete charge from property line to property line with the possible exception of the policing of the way, and those sometimes called State-Aid roads where the Commonwealth has little or nothing to do with the maintenance of the roads and the burden is placed by law upon some subdivision of the State, usually the county.

The writer has had to do only with the class of State highways first mentioned and he believes that the State ought to have as complete control as possible over its highways, State or otherwise. Such control, however, places a considerable burden upon the authority which administers the law.

More is expected of a State organization, and rightly so, than of a county board. Its work must be done carefully and accurately. The surveys and plans of the State highways must be well made and no small part of the engineering costs is chargeable to the careful work needed in running out and establishing the right of way lines.

In trying to establish old right of way lines in anticipation of highway improvements, much difficulty is often experienced in finding any landmarks to indicate what the right of way really is, and the old surveys and plans often prove to be of little assistance. Often the roads to be taken over and built as State highways were laid out when the land was of little value and the surveys were carelessly made or the descriptions carelessly recorded. With the lapse of time buildings, trees, and other similar features, which formerly marked the location of the road, have entirely disappeared, and the traveled ways have shifted from place to place as the action of the elements or the whims of the travelers have directed. Fences, if they exist, have been so moved about that they in no way indicate the original line of the road.

In all State work with which the writer has had to do it has been the policy to fix the right of way lines on the ground by setting proper monuments into the soil to such a depth that they serve as markers for all time to come.

In planning a new system of highways, careful plans should be made and permanent monuments set. Future generations will surely appreciate such records and the additional cost of this kind of work should not forbid.

THE CHAIRMAN: The discussion of this paper will be opened by Mr. W. S. Gearhart, Highway Engineer of Kansas.

MR. GEARHART: Properly located public roads mean so much for the safety of the traveling public, economy in transportation, and the reduction of the expense of up-keep on highways, that all who are interested in road improvement will be very grateful indeed to Mr. Fletcher for the valuable suggestions in his excellent paper on "Rights of Way."

The time to solve the right of way problem, as Mr. Fletcher states, is now. No part of the highway is so permanent as its location and after the location has been firmly established in a certain place no part of the road is so hard to improve as the right of way.

The greater part of Mr. Fletcher's paper has to do with the problems involved where the State Highway Department selects the rights of way for roads on which the State proposes to make extensive improvements, and the methods described are not unlike the best railroad practice, except possibly in the matter of land titles, which the railroad companies are very particular about, for reasons which are evident.

The writer has not been connected with State highway work of this kind, but on railroad location has had all the experiences incident to facing a double barreled shot gun and recalcitrant land owners.

The roads that straddle the section lines are the ones most of the good road advocates in the Central West are especially interested in, for like Mr. Lincoln stated concerning the common people, there are so many of them. Too many miles of roads have been opened in these States. This is particularly so in Kansas, except in the western third of the State, where there is a highway on practically every section line, and in many cases the half section lines have been opened.

With such an established checker-board system there is little the engineer can do in the matter of new road locations without specific authority except to agitate and educate and to parallel the railroads until the State begins to participate in road construction and maintenance.

Those living outside the prairie country no doubt wonder how the highways came to be located astride these imaginary lines. The Central West was surveyed, mapped and the corner stones set, by the United States Government at an early date, and the country was divided into rectangular counties, townships six miles square, sections one mile square, and quarter sections. This provided an easy, practical, accurate, convenient method of making the surveys, fixing the boundary lines and recording land titles, and all deeds at the present time refer to the township, range and section. It also had the further advantage of dividing the farms into the most practical form and it is only natural that the owners of these farms should insist that the land be not cut up by diagonal rights of way —hence the section line roads.

The trails, military highways and other early roads of Kansas were located by the old plainsmen, and the United States military engineers, on the most direct routes and on the best ground available, as Mr. Fletcher is insisting that the State roads in California shall be today.

One of the territorial road laws of Kansas, enacted in 1860, reads in part as follows:

That each territorial road shall be laid out from the place of beginning to the place of termination on the most direct route, where suitable ground can be found to establish the same.

In 1861 the Legislature of Kansas enacted a law providing for the establishment of forty-five State roads covering all sections of the State. The act specified the cities or towns which each of the several roads were to connect, and named the three men who were to act as commissioners in locating each road. The commissioners were required to locate these roads upon the best possible ground consistent with the most direct and practical route and to as nearly as possible avoid in all cases making two or more angles where good ground for a road could be had upon a direct course with but one angle.

This was a good beginning, and at the present time few States in the Union have statutes governing highway location so commendable as these. Unfortunately, however, in 1861, during the same session of the legislature at which some of these excellent highway provisions were enacted, a special law was passed declaring all the section lines in Brown County to be the centers of the public highways whenever any road was opened for traffic by order of the county commissioners.

This measure looked innocent, no doubt, for it was entirely a local proposition, and applied only to Brown County. The necessary road surveys and views were expensive, at least they were considered so at that time, even though the cost probably did not exceed $5 per mile. In one early statute this expense was limited to $3 per mile. This section line road measure was no doubt enacted in the name of economy, as most of the other blunders in highway improvement are made.

In 1871 the section lines in fourteen other counties were declared to be the centers of the public highways and from that time on the roads have been laid out almost exclusively astride the section lines, regardless of the proper location, hills, character of soil, safety of traffic, first cost maintenance expense, or convenience or economy of traffic, and now only in rare instances is any part of the original trails or territorial or State roads left, except such as follow the section lines.

In the cattle country of the extreme western part of the State where there are few fences most of the roads used today follow the natural locations on the most direct routes on the high ground. These roads, however, are not legally laid out, and strange as it may seem, when they are officially opened they are almost always bisected by a section line.

All highways at the present time are laid out on petition to the county commissioners by twelve free holders who live in the immediate vicinity of the road. The petition must specify the place of beginning, the intermediate points, if any, and the place of termination of such road. The statute provides that the width of the right

of way shall not be more than sixty feet or less than forty, the exact width to be determined by the viewers at the time of establishing the road.

If the county commissioners pass favorably upon the petition they may act as a board of viewers or they may appoint three viewers to definitely locate the road. Generally the appointed viewers have no interest whatever in the road or desire it to be located on a certain section line, and in either case the interests of the individual land owners prevail at the expense of the public welfare. The statutes do not now require the highways to be located on the section lines, but public sentiment does, which is just as bad, if not worse.

The statutory provisions for locating highways in the other Central West States are not, and have not been, unlike those of Kansas, and the evolution of the section line roads has been the same, always selfish and at the expense of the public.

Some of the advantages of the section line roads are: The elimination of local strife in establishing locations; little or no trouble to get a road as compared with the method of petitioning and viewing; low cost for views and surveys; relatively low damages for rights of way, since such a road would generally be located along the side of the farm instead of dividing it; the lessening of the area of land deducted from the holding of any owner by requiring his adjoining neighbor to furnish half the roadway, as stated by Mr. Fletcher; the elimination of sharp angles in the fields; greater ease in farm operations in the fields adjoining the highways, this is especially true where large machinery is used; the facility with which strangers can follow the highways; and most important, a majority of the people believe that the road should be there, and that no land can be spared for highways any place else.

Probably no enumeration of the disadvantages of the section line roads would include all the objections. However, some of the worst ones are: The resulting large number of unnecessary excessively steep grades, expensive bridges and culverts, dangerous railroad crossings, and sharp angle turns; the practical difficulties in relocations; the increased distance around the two sides of a right angle triangle as compared with the length of the direct road located on the hypothenuse of the triangle; the zig-zag traveling or sail boat like tacking necessary to reach any given point except, possibly, due east, west, north or south; the bad soil conditions often encountered; the high first cost, and expensive maintenance; increased transportation expenses due to the longer haul and extra time required to reach market; nine times out of ten the section line is not located where the road should be and the highway that straddles the section line is nearly always located in the interest of the individual instead of the public.

The practice of section line road location has been followed so long that it is now not uncommon to see all other considerations wholly disregarded. The writer, while employed on some drainage

work straightening a stream, met an old lady who was opposed to the improvement and she gave as her reason that if God Almighty had not wanted the stream located just where it was He would have put it some place else. A good many people seem to have the same opinion of the government made section lines and the location of the highways, as evidenced by the following examples:

A mile of road was recently opened in the rolling prairie country of Kansas on an east and west section line. This mile of road crosses the same stream three times and a more scenic route could probably not be found in any White City. The expense for bridges was about $5500 and for grading $2500, or a total of about $8000 to make the road passable. The highway benefited only four men, whose property is not worth as much as it cost to open the road. By establishing one and one-half miles of north and south road only one bridge would have been needed and the same purpose would have been served at a total expense of about $2000. The writer advised the county officials in this case to buy the farms and rent them for pasture rather than fasten upon the county indefinitely the maintenance of such an abominable road.

In 1905 a $2500 bridge was built on a section line and $1000 was expended for grading. Then the bridge and the work was abandoned and it has never been used, for it will require an additional expenditure of $3000 to obtain a 13 per cent approach grade. By placing the bridge at the ford on the old natural road only 225 feet off the section line a very good road with a 6 per cent grade could have been had at a total cost of not to exceed $2500.

Less than four miles from the bridge referred to above another $1800 section line bridge was built against the face of a rock bluff. The east approach has never been made and on the west end at 130 feet from the end of the bridge the rock bluff is forty-two feet above the bridge floor. About $150 was spent in quarrying rock to make an approach and then the work and the bridge was abandoned, for the only practical way to make a road at all on this section line at this point would be to construct a tunnel. By moving the bridge 120 feet to the old ford a good crossing and a water grade around the bluff could have been had without any change in the present road. The distance around the bluff is practically the same as over it.

Where the railroads run diagonally across the sections it is not uncommon to see two unnecessary, dangerous, highway grade crossings within a quarter of a mile and often much closer. Apparently it never occurs to the viewers that in such cases the highways should parallel the railroad.

On account of the local influences and the lack of proper information the average road viewers cannot handle this problem of rights of way alone, satisfactorily. The State Highway Department should approve the location of all main roads before they are improved and until this is required by statute there is little or no hope for much favorable change in the States where the highways

ride the section lines except by paralleling the railroads. The streams are too crooked to make it practical to parallel them.

THE CHAIRMAN: We will proceed with the next paper on the program, "Drainage Structures," by Mr. W. E. Atkinson, State Highway Engineer of Louisiana.

DRAINAGE STRUCTURES

BY W. E. ATKINSON

State Highway Engineer of Louisiana

Drainage structures like many other features of highway construction require the consideration of many factors in determining the type and character of construction adaptable to any particular location, or in determining a uniform standard or design to be used throughout any particular proposed highway project. Inasmuch as road construction together with drainage structures are more or less problems to be solved by every State or highway commission to meet local conditions, I shall not attempt to set forth any rules or plans governing the type or construction of all drainage structures, but merely present to you some of the general methods, factors and policies governing the construction of such drainage structures in Louisiana, under the supervision of its highway department.

In determining the length of bridges and spans between bents and piers and the size of culverts, consideration is given to the maximum rainfall, amount of run off, average slope of ground of drainage area, seepage, etc., as included in the same factors governing similar structures under railroad construction. After determining the required opening for waterway, the factor governing the required strength or carrying power of the structure is determined, so far as it is possible, upon the maximum load the structure is likely to be subjected during its bonded life. As to the bonded life of structures of this character, it is figured that they should last until bonds or taxes voted for the construction of same are retired, all structures being computed, however, to safely carry a minimum live load of not less than ten tons, plus 50 per cent impact and a factor of safety of four.

It has been the policy of the highway commission of Louisiana to construct, whever funds and conditions will permit, permanent structures and adopt uniform and standard plans for bridges and culverts for any particular highway project, however, oftentimes different designs are necessary to meet existing conditions, the type and design of bridges, whether they be of wood, concrete, or masonry, etc., are determined largely by the amount of funds available, and the character and nature of soil for foundation.

Due to the alluvial character of the soil, with the exception of some sections in the northern part of the State, there are instances

where it is not safe nor economical to construct the arch type of concrete bridges; even with some of our girder and slab bridges, it oftentimes becomes necessary to provide pile foundations for the piers, abutments and wing walls. In some places it is necessary these piles be of concrete instead of wood on account of many reclamation projects, now under way, lowering the ground water which would become detrimental to the latter type of construction.

We have found it advantageous and economical to provide, where conditions will permit, a uniform design for all drainage structures, especially for those of concrete construction, that the contractor may use the same drainage forms over and over, permitting thereby much lower bids per cubic yard on such work than otherwise under a system of non-uniform standard designs for such structures, and in addition, many times permitting, without greater cost, greater waterway opening than theoretically computed, resulting in a larger factor of safety, and often providing for some unprecedented rainfall or cloudburst not anticipated. In addition to concrete bridges, the department is building many wooden bridges, both of creosoted and uncreosoted materials, this character of construction predominating in some parishes due to lack of funds for more permanent construction.

The department has installed several types of culverts, that of vitrified clay, cement, concrete, cast iron, wood, corrugated galvanized iron, etc., the type of construction being governed by the available funds and topographical features together with character of soil encountered in foundation, however, where practicable, concrete has always been recommended.

At many places, however, we have found it impracticable and not economical to use concrete culverts and others of a monolithic character, especially in some of the bayous and coulees. In one place in particular, it is recalled, where the foundation in one bayou was so poor that a strip 2 inches by 2 inches by 16 feet was pushed down its full length in the bottom of the bayou, and could have been pushed farther if the strip had been longer. This bayou was 250 feet wide across the top and 25 feet deep, and the only opening necessary was that of an equalizer with an area of some 28 square feet to be filled over with earth, thereby making a bridge of earth and of an equalizer. The equalizer installed at this particular location, was a ten gauge 6 feet diameter corrugated galvanized iron pipe culvert. The entire cost of this combination bridge, if it may be so termed, amounted to $2,059.27, including an item of $215.73 for riprap, whereas to have bridged the bayou with concrete, or to have attempted to build a concrete culvert, would have made the cost very much in excess of this amount. The only weak point I see, relative to this construction, is the more or less uncertainty as to the lasting qualities of the culvert from corrosion. This is stated merely to show some of the conditions that have to be met in Louisiana.

Due to débris, drift wood, and other extraneous matter, our high-

way department has adopted a policy not to install any culverts of less than 18 inches in diameter where possible, it preferring that they should be not less than 24 inches in diameter.

No doubt many of you will take issue with me on this point, but my experience has been that culverts of these sizes have proven more satisfactory and given better service, requiring less maintenance both for road and culvert at such places than when culverts of less diameter are used, even though the smaller culverts are ample to carry the water, due to the ineffectiveness of the latter from drift choking and filling them up.

I have yet to find my first culvert that is too large for the amount of water and rainfall to be drained, but many have I found that were too small.

THE CHAIRMAN: The discussion of the paper just read was to have been opened by Mr. S. D. Foster, Chief Engineer of the State Highway Department of Pennsylvania. In his absence Mr. Willis Whited, Engineer of Bridges of Pennsylvania State Highway Department will open the discussion.

MR. WHITED: The paper just read is very interesting to me, but the conditions in Louisiana are very much different from those in Pennsylvania. In Pennsylvania we have a smaller rainfall than in Louisiana, but we have steep slopes so that the water has great velocity sometimes and we seldom have any great difficulty about foundations. Where we do have soft foundations like those mentioned, it is very common practice for us to build a rectangular culvert and make the bottom strong enough to distribute the load over the whole of the bottom. That not only checks the erosion due to the water flowing through, but also distributes the foundation load enough so that there is very little difficulty about settlement. In that case of course the culvert would have to be reinforced longitudinally also, so that if the load was heavier in the middle it would not crack crossways. Now much has been written about the strength, stability, etc., and the proper loading of culverts, but comparatively little literature is available on the action of the water. A culvert has to perform two offices; it has to carry the traffic overhead and it has to carry the water under. Now in providing for that purpose we are very careful especially in Pennsylvania where we have high velocity of water, to arrange it so that the water enters the culvert with as little deflection of the current and as little obstruction as possible. We usually flare or wing walls about 30 degrees from the line of the stream so that it acts really as a juttage and we have to put a wall down at the head, if it is soft ground, to prevent the water getting under it. We often pave the bed of it for the same purpose, but even with our assistant engineers I have some difficulty in persuading them to give the bottom of the culvert all the slope possible. Some of them

insist on making it nearly level and then having the debris accumulate on the underside where they can clean it out. I tell them, "Give it all the slope you can, give the other fellow the chance to take it up." It is a good deal cheaper for the Highway Department if the other man clears away the driftwood and the debris than it is for the department to do it, and in doing so, there is also some difficulty occasionally in preventing serious erosion on the down stream side. We find the erosion due to water is usually much more severe on the down stream side than it is on the upstream side, so that we have to take more precautions with it. I have seen culverts with good paved bottoms grouted in and made in nice shape and the water gets to cutting a little on the downstream side, and then it cuts back and cuts back and I have known that to be cut down four feet, and half of that paving destroyed. But that is a thing that we preach to our men all the time, in season and out of season, to give the water as free an entrance as possible into the culvert, as rapid a passage through as possible and a safe exit after it gets out, in such a way that it will erode the soil as little as possible, and in that way we reduce the cost of maintenance, reduce the necessary size of the culvert and get much more satisfactory results all around.

THE CHAIRMAN: The next paper is by Mr. A. D. Williams, Chief Engineer State Roads Commission of West Virginia.

GRADES AND EXCAVATIONS

CONDITIONS DETERMINING MAXIMUM GRADES—METHODS AND COST OF GRADING AND EXCAVATING—ECONOMIC CONSIDERATIONS

BY A. D. WILLIAMS
Chief Road Engineer State of West Virginia

In the past two or three years stress has been laid upon the subject of permanent roads. Many articles have been written bearing upon the various kinds of surfaces, but the ever-important subject of grade and excavation has received only passing notice. Yet the only permanent thing about a road is its grade and location. The various kinds of surface will yield to the actions of the elements and pass the march of time, but the road once established will become more fixed as the years go by, adding improvements and new property lines to bind it firmly in place. This makes more important the engineering subject of our roads. The establishment of grades and location should be given the greatest consideration.

THE MINIMUM GRADE

The principal factor entering into the determination of a minimum grade is the question of sufficient drainage. Except on fills

over 2 feet the minimum grade should not be less than three-tenths ($\frac{3}{10}$) of 1 per cent and preferably not less than five-tenths ($\frac{5}{10}$) of 1 per cent.

THE MAXIMUM GRADE

There are a number of factors that enter into the maximum grade, but, before attempting to locate any road or to establish any grade the engineer should make a thorough study of the territory to be developed by the proposed road giving due consideration to the following points:

First. What will be the present and future demands of the territory adjacent to the proposed improvement;

Second. What are the possible developments in the territory from an industrial, agricultural, educational and social standpoint.

Third. What part will the proposed road be of a general system of roads reaching to other communities and what will be the effect of the improvement on other sections;

Fourth. The nature of traffic that the road will be called upon to take care of, making due allowance for development, considering the present and future tonnage;

Fifth. The general direction in which the greatest amount of tonnage will be transported, the class of tonnage and the time necessary to move it in order to make it the most marketable;

Sixth. The direction in which the ascending grade will be in comparison with the possible traffic demands;

Seventh. The maximum load that a horse can pull based upon the length of grade and the time required to make the trip, from the standpoint of the horse and the time necessary to get the best results for the kind of material the country will produce;

Eighth. Consideration should always be given to climatic conditions and to the season that the roads will be required to take care of the heaviest traffic, as well as a study of the foothold for horse-drawn vehicles. The possible amount of frozen or icy weather should be noted in determining a maximum grade;

Ninth. The class of material over which the road is to be made and the cost of construction on the longer distance compared with the steeper grade and shorter distance have a certain bearing upon the subject, because the most important subject in connection with the cost of roads on grades is that of maintenance which increases very rapidly with the increase of grade. Roughly speaking the destructive effect of violent and periodical storms is four times as great on a 5 per cent as on a level ground, and nine times as severe on a 10 per cent as on level grade. Thus if no other factors were to be considered on earth roads alone the cost of upkeep in a very few years would justify the elimination of bad grades;

Tenth. The condition of the right-of-way and the possible chances for disposition of water and drainage are factors of much importance when considering the maximum grade, because on steeper grades the

increasing velocity demands more drainage and greater skill in handling the water, which, if kept on or near the road will soon destroy it.

Eleventh. The consideration of a grade from the ascension is not the only angle of approach in the location of highway grades because important items enter into the descending grade that should be given as much, if not more, consideration than the ascending direction;

Twelfth. A grade should not be steeper than a horse can descend safely in a trot;

Thirteenth. A grade should not be steeper than a team can safely descend with a load that it can handle for ten hours under normal conditions, exerting its normal tractive force.

Fourteenth. The amount of time necessary to descend a grade should be considered making due allowance for the maximum speed that can safely be used on that grade;

Fifteenth. The highway engineer of today must remember that as time passes the motor traffic requirements of the public highway will be more and more exacting. Experiments as to gasoline consumption and its efficiency on difficult grades and materials are now being conducted near Uniontown, Pennsylvania, by Mr. R. O. Gill, Experimental Engineer for the Chalmers Motor Company of Detroit, Michigan. In this connection we have but little data. Some recent experiments made by Mr. H. Kerr Thomas and Mr. D. Ferguson of Buffalo, New York, for the Pierce-Arrow Motor Company, show that the class and kind of surface exert more influence upon the motor-driven truck than the percentage of grade and that it requires practically the same tractive force on a 1 per cent grade in sand and loose stone to handle the same load as it does on a 27 per cent grade on concrete, asphalt, new brick and first-class macadam. But observations of the speaker lead to the conclusion that grades of any length exceeding 5 or 6 per cent are not as satisfactory and as economical as lighter grades for motor traffic owing to the increased hazard, increased consumption of gasoline, and loss of power due to the resistance to gravity. The speaker's observation further concludes that in frozen or icy weather motor traffic is extremely hazardous on grades exceeding 10 per cent, and entirely unsafe on grades exceeding 16 per cent;

Sixteenth. Grades crossing a summit should merge into each other by some form of vertical curve. The speaker has been accustomed to using the following formula which proves satisfactory and practicable. Take the summit grade at e and a grade point 100 feet on each side or any other desirable distance and by use of either one of the following formulas find the elevation at f which will be half-way between e and g, then by use of the formula find the offset from the tangent at each of the ordinates. This subtracted from the elevation of the ordinate will give the true elevation of the grade.

By reference to Gillespie whose work contains about all we have upon tractive power of a horse, which embraces the experiments of Sir John McNeil, Sir Henry Parnell, and Mr. Cayffier, some of whose works are quoted by nearly every writer, we find that a horse traveling at the rate of two and one-half miles per hour can exert 10 per cent of his weight, and travelling at the rate of four miles per hour, can exert 6 per cent of his weight. These observations prior to 1850 and just before the advent of the steam road into our field of engineering embrace about all the experiments we have excepting the work of Mr. E. B. McCormick of Kansas State Agricultural College and the works of Prof. J. H. Waters of the University of Missouri, and other work by Mr. McCormick is now being done for the Office of Public Roads, at Washington. The speaker's personal observations have shown that a horse for a limited period can exert one-fourth and sometimes even greater percentage of his weight, this depending in a measure upon the kind of shoes on the horse and the foothold on the grade. A horse on a road material that offers safe footing can be safely trotted down a 5 per cent grade, but cannot be trotted down this heavy a grade for any great length of time without injury by "jamming or stoving him up." Therefore, the ruling grade should not exceed 5 per cent, if for a horse-drawn vehicle over which speed must be made on the descending grade because the average horse in walking down a grade will not make over four miles per hour, while he will trot twelve miles per hour, thus, from this standpoint, we can double the distance of the road and increase the time 33⅓ per cent. The speed of twelve miles per hour should not be undertaken down a grade of more than 3 per cent with a vehicle bearing any kind of a load. In ascending a 5 per cent grade the capacity of the team is about four-tenths of its capacity on level ground and about one-fourth of its capacity on 10 per cent grade, on a loading for the same tractive exertion, but a point here that should not be forgotten is that for a short duration a horse can exert from 25 to 40 per cent of his weight, thus doubling and quadrupling its normal tractive force and in this connection it is often economy, considering the financial condition of the community to put in a short piece of 6 and even 7 per cent grade, than to expend a large amount of money in making an exhaustive and expensive cut, especially so if the cut must be made at the expense of development in some other part of the community. One thing that should be borne in mind is that each year's development of our country makes the chances for changing of grades and their elimination less possible, and that while the improvement of the surface of a road increases its tractive efficiency about 200 per cent on level ground it only increases about one-fourth for a horse-drawn vehicle on a 10 per cent grade, thus money expended in decreasing the grade within a reasonable amount of distance is the best possible investment.

Then with these conclusions drawn and a decision as to the kind

of surface that will possibly be placed upon the road at some future time, we are in position to determine what should be the maximum grade.

METHODS AND COSTS OF GRADING AND EXCAVATING

This is a machine age and wherever grading can be done by machinery it is usually more economical. The following table based upon figures taken from different pieces of work is approximately correct to a wage scale of 15 cents per hour and capable supervision.

Picking 5 cts., Plowing 2 cts., Steam plowing 1.5 cts. per cubic yard. Hauling by wagon approximately 35 cts. per cubic yard. Hauling by trucks and tram 14 cts. per cubic yard.

DISTANCES HAULED	COMPARATIVE COST PER CUBIC YARD FOR MOVING EARTH WITH								
	Wheelbarrow	Drag or Slide Scraper	No. 1 Wheel Scraper	No. 2 Wheel Scraper	1 Horse Cart	Wagon	Tractor and Trucks	Grader	Casting Over Bank
Feet									
100	$0.057	$0.090	$0.100	$0.100	$0.056	$0.095	$0.080	$0.022	
200	0.114	0.135	0.130	0.125	0.068	0.103	0.080		
300	0.170	0.180	0.160	0.150	0.080	0.111	0.080		
400	0.230	0.225	0.190	0.175	0.090	0.119	0.080		
500	0.285	0.270	0.220	0.200	0.101	0.127	0.080		
600	0.342	0.315	0.250	0.225	0.112	0.135	0.080		
800	0.457	0.405	0.310	0.275	0.135	0.151	0.080		
1000	0.570	0.495	0.370	0.325	0.160	0.167	0.090		
1500	0.857	0.720	0.520	0.450	0.214	0.207	0.090		
2000	1.143	0.945	0.670	0.575	0.271	0.247	0.100		
3000	1.713	1.395	0.970	0.825	0.388	0.327	0.100		
4000	2.280	1.845	1.270	1.075	0.500	0.407	0.100		
Loading by hand									
	0.050	0.010	0.010	0.010	0.130	0.130			0.100
Loading by steam shovel									
					0.060	0.060			0.060

By a glance at the figures it will be seen that at 22 cents per yard or at the same cost for any given ratio the ratio cost distances are for wheelbarrow, 200 feet; drag scraper, 400 feet; wheel scrapers, 500 and 600 feet; one horse cart, 1500 feet; wagon, 1800 feet, while tractor and truck on track do not reach the amount within one mile. The cost of grading depends materially upon the class of material, the location and the management of the operation. In McDowell County, West Virginia, a contractor failed on a contract at 65 cents per cubic yard, for a material running about 60 per cent soft sandstone rock, and 40 per cent earth. The county purchased a steam

shovel and moved the material at a cost of 19 cents, including explosives, drilling and shooting. This was casting work on heavy hillside grade. Thus the contract price to the county was $13,000 for the 20,000 yards. The cost of the labor and explosives, upkeep of the machine was $3800. The cost of the machine including drill and compressor was $5500, or a total of $9300 including the cost of the machine, leaving the county a profit of $3700 in cash and the equipment.

In Marion County, West Virginia, a contractor recently contracted for a piece of work unclassified at 46 cents and the work cost 52 cents, this was done by steam shovel, being about 70 per cent rock and 30 per cent earth.

In Mercer County, West Virginia, Walton and Company have contracted for grading of nine miles of road at 48 cents per cubic yard unclassified which work is running about 7360 cubic yards per mile.

In Pleasants County, West Virginia, material running about 80 per cent rock, and 20 per cent earth costs 83 cents per cubic yard to grade by day labor at 20 cents per hour, teams at $3.50 per day. On the same piece of work with prison labor on the honor system which costs 75 cents per day and teams $3.50 per day, the grading cost 30 cents per cubic yard.

In Kanawha County, West Virginia, the Atlantic Bitulithic Company has a contract for three miles of road grading and surfacing. The grading is contracted at $1.25 for stone and 34 cents for earth classifications running about 70 per cent and 30 per cent earth, or an average of 97.7 cents per yard. The State has a prison camp working on the honor system under a competent engineer and is moving the same class of material at 24 cents per cubic yard.

Then as to methods the speaker would suggest the use of machinery wherever possible under competent supervision and under proper direction and to make use of the State and county prison labor. On work that is light and on which machinery can be employed the work should be done by day labor. On heavier work and large quantities the speaker would recommend contracting and to the contractor a systematic organization of his work so as to get the most efficient service from his men and equipment. There are volumes written covering the subject of Cost Data in heavier work but the speaker's experience in highway work leads to the conclusion that there are many elements entering into the cost of highway construction that are often overlooked when comparing this class of work with heavier work. One point of deficiency that has been noticeable and should be emphasized here is the lack of organization in highway construction in the various sections of the country. In many instances 50 per cent of the cost could be saved by an adequate organization.

ECONOMICAL CONSIDERATIONS

The economical phases of highways and highway construction are many, and call for more time than the speaker should occupy. We might say that in studying the history of highways and highway economics that it can be divided into three periods: The Roman or Ancient Road, the Telford and MacAdam period, extending from 1750 to about 1840, and our modern or twentieth century awakening. The Roman road with its 3 feet of stone was reduced about one-half in the days of Telford and MacAdam and now with modern machinery we are constructing macadamized roads in West Virginia at costs ranging from $1000 to $4000 per mile, concrete from $7500 to $12,000 per mile, and brick from $9,000 to $20,000 per mile. It should be borne in mind, that the cross section of a road should be so as to permit the greater portion of the work to be done by machinery on ground where machinery can be operated, and that an extra width of the road on hillsides increase the cost. A road on hillsides should not be wider than is needed to care for the traffic. In county districts a 9-foot concrete bituminous or brick or a 10-foot macadam with 5 feet of earth on each berm will meet all the requirements at much less cost.

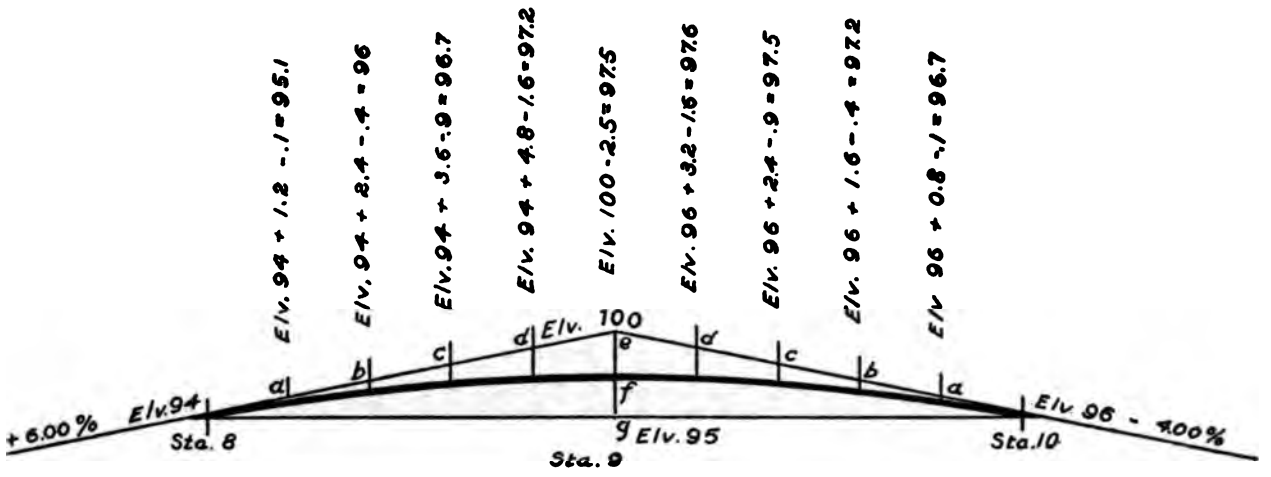
On ground free from roots and stone, where a road machine can be used the material can be moved at a cost of less than 5 cents per yard, and on hillside grading where the work is casting a small steam shovel is an economical machine to use. With this should go a drilling outfit and attachments so it can be operated with the same power. Barbour County, West Virginia, this season purchased a tractor and heavy grader for each district, equipped them with drilling outfit and with less money than they expended in 1913 without showing visible improvement upon their roads and have graded nearly all of the roads of the county in good shape.

In conclusion I want to say that the most economical thing a community can do is to improve its roads so as to serve all its demands and to do this, it should employ a competent highway engineer to make a careful study of the needs of the territory, its financial ability to construct and maintain a road and to locate and superintend the construction of their road for them. When the road is constructed a competent patrolman should be placed on it to continually keep up the maintenance and repairs. Many of our paths and by-ways were not located by men or by engineers but were the foot-prints of the primitive mound builders, the buffalo, the deer and the wild animal that wandered to and fro in the wildwood. Thus our roads need revising because

> One day through the primeval wood,
> A calf walked home, as good calves should;
> But made a trail all bent askew,
> A crooked trail as all calves do.

Since then two hundred years have fled,
And, I infer the calf is dead.
And from that day o'er hill and glade
Through those old woods a path was made;
And many men wound in and out,
And dodged and turned, and bent about
And uttered words of righteous wrath
Because 'twas such a crooked path.
This forest path became a lane,
That bent, and turned, and turned again;
This crooked lane became a road,
Where many a poor horse with his load
Toiled on beneath the burning sun,
And traveled some three miles in one.
And thus, a century and a half
Trod in the footsteps of that calf.
The years passed on in swiftness fleet,
The road became a village street;
And this, before men were aware,
A city's crowded thoroughfare.

And soon the central street was this
Of a renowned metropolis.
And men two centuries and a half
Trod in the footsteps of that calf.
Each day a hundred thousand rout
Followed the sigsag calf about;
And o'er this crooked journey went
The traffic of a continent.
A hundred thousand men were led
By one calf near three centuries dead.
They followed still his crooked way,
And lost one hundred years a day;
On some roads the first engineer
Was a wild beast or fleeting deer,
Road Builders, be sure when you laugh,
That you're not trailing a calf.
For such a reverence is lent
To well establish precedent,
That men are prone to go it blind
Along the calf paths of the mind,
And work away from sun to sun
To do what other men have done.
They follow in the beaten track,
And out, and in, and forth, and back,
And still their devious course pursue,
To keep the path that others do.
But how the wise old wood gods laugh
Who saw the first primeval calf.
Ah! many things this tale might teach
But I am not ordained to preach.



$\frac{1}{2}(94+96) = 95$

Each Slope is divided into five equal parts

$\frac{1}{2}(6 - [-4.7]) \times 2 = 2.5$

Second method $\frac{1}{2}[100 - 95] = 2.5$

$95 + 2.5 = 97.5$ Elv. f.

a a. $= (\frac{1}{5})^2 \times 2.5 = 0.10$
b. b $= (\frac{2}{5})^2 \times 2.5 = 0.40$
c. c $= (\frac{3}{5})^2 \times 2.5 = 0.90$
d d $= (\frac{4}{5})^2 \times 2.5 = 1.60$
f $= (\frac{5}{5})^2 \times 2.5 = 2.50$

THE CHAIRMAN: The discussion of Mr. Williams' paper will be opened by Mr. William R. Roy, State Highway Commissioner of Washington.

MR. ROY: I have been asked to lead the discussion on Mr. Williams' paper "Grades and Excavations." I have no disposition to criticise Mr. Williams' findings. He has handled his subject with skill, and in a very painstaking manner, and I am sure that you gentlemen who have had the privilege of hearing him feel well repaid for your time.

The question of grades is a very important one, and we in the State of Washington find the extremes confronting us on every hand, and on account of the topography of our country we are compelled to keep close to water grades, hence we cannot make our locations on section or township lines, except in very rare cases. We have a large State in which are more than 40,000 miles of roads without counties, the winding calf trails that Mr. Williams refers to.

We are fortunate in our State to have a governor, who is not only a road enthusiast, but a practical road builder of large and varied experience, and being chairman of the Highway Board is a tower of strength to the working force of the department. The other members of the board are equally zealous and enthusiastic and under their guidance we have during this biennium completed 233.5 miles of State highways, and we have completed 442 miles of permanent highways. This represents most all of the different types of surface. In addition to the above the counties have built during the biennium 1900 miles of road, or a grand total of State and county roads of 2343 miles of roads. The State roads are cleared and graded, ditched and drained to standard plans with concrete culverts—bridges designed to take care of future traffic. Our maximum grade is 5 per cent. We have just completed a section of the Sunset Highway over the Snognalinie Pass in the Cascade Mountains. There is no grade on this road exceeding 5 per cent. This was a gigantic undertaking, but with an efficient engineering force and the coöperation of a competent contractor we have exceeded our expectations, and opened for tourist traffic next year across the State that the people of the State and nation will be proud of for all time to come. The scenic beauty along this road is unsurpassed anywhere in the world. The drainage problems in our State have to be handled according to local conditions. Formula used with satisfaction in eastern Washington where there is light rainfall would not be adequate on the west side of the State where there is very heavy precipitation. There we are compelled to spend a great deal more money per mile for drainage.

During this biennium we have expended for State roads $2,000,000, for permanent highways $3,264,091, and in addition to the above expenditure of State moneys the counties have expenditure for new construction $4,533,000 and for maintenance during the same time

$3,220,000. Taking the total mileage in the State the cost of maintenance is about $43 per mile. Most of the counties in the State are well organized for helping the cause of road building, and the Highway Department has been fortunate indeed to have had the hearty support and coöperation of all the county commissioners, engineers, supervisors and good roads associations all over the State.

THE CHAIRMAN: Secretary Pennybacker has a letter he desires to read.

THE SECRETARY: This is a letter just received from President Woodrow Wilson:

Mr. Austin B. Fletcher, President of the Fourth American Road Congress, Atlanta, Ga.

MY DEAR MR. FLETCHER: I regret that I am compelled to forego the pleasure of attending the Fourth American Road Congress. May I ask you to convey to the members of the Congress my deep interest in the important work they are striving to promote? I need scarcely emphasize the social and economic importance of good roads. They are prerequisite to the betterment of rural life in a number of directions. Improved roads, especially improved community roads from the farm to the nearest railway station, are an urgent necessity. They are essential for the economical marketing of farm products, and for the development of the educational and social institutions of the country. As important as the matter of providing additional funds may be even more important are the matters of better road administration and the better maintenance of roads already constructed. The nation is now expending more than $205,000,000 annually for the construction and maintenance of roads, and it is clear that we are not getting the results we should have. The proper planning for road systems in States, the development of better methods of administration, State and local, and the proper maintenance of roads, will, I am sure, receive peculiar attention from your body. When the people are convinced that they will receive full value for every dollar expended on roads they will be brought more easily to an appreciation of the need for future expenditure and will make the requisite provision. I believe that your body can furnish intelligent guidance in the solution of our problems in this field. Sincerely yours, (Signed)

WOODROW WILSON.

The White House, Washington.

MR. MURPHY (of Pike County, Ga.): *Mr. Chairman:* In looking over the list of distinguished speakers at this Congress I fail to find any of the ear-marks of the farmer, the man who is more intensely interested in good roads because it is the foundation and

the bed rock of all development and uplift of the agricultural interests of this country; I mean the farmer who lives, moves and works upon the farm and is dependent upon the results of those farm operations. If I did not fear that I would shock my hearers, I would claim that this good roads movement is of far more interest to the farmers of the South than any coöperative bank loan or government aid to relieve the present conditions, for just so far as the farmers' obligations are increased in connection with present conditions, just that far will you distract his brain and energy from farm operations of the future which are so necessary for his success. But in travelling over this State from near the line of Florida to the line of Tennessee, I find that wherever there is a short stretch of good road, upon that you see farm homes that are attractive, upon that you see commodious barns, you see fences well kept up and painted; you see flowers in the front yard and everything is an evidence of thrift and good living. The land surrounding these farm homes is worth $50 to $200 per acre. On the contrary when you reach a stretch of road where it is almost impossible for a team to pull one bale of cotton, you see the farm home of the past occupied by negroes, falling down, dilapidated, the barn consisting of a little log house of about 10 x 15, the fences falling down, if you find any; the grass is growing up to the front steps of the little dilapidated residence; the land around such a habitation has no market value; no one wants to live in a community where it takes all of his motive power to carry one bale of cotton to market. Now I have a few criticisms to pass upon the road work of the present. I believe in reducing these things down to hard tacks. The farmer is the man who is dependent entirely upon the dirt roads of rural districts. What is the road work of the present? Simply temporary; it is dry weather road work. Your road force goes along today, grades the road if it grades it at all, crowns it up, irons it over with a scraper and leaves it. What is the result? Tomorrow your rain comes, and for the next ten days the road is almost impassable. That road force will not get back to that road for something like a year or two years. Not only that, but here is an elevation, there is a depression, there is another elevation; he crowns up his road and runs all of that surface water down to the depression and makes no disposition of the water collected there. And there is a gully washed across the roadway for the unsuspecting automobilist at night and away goes his front axle and spring. Now that is what I see in traveling over Georgia; that is the result of the road work we are getting; that is the kind of work our taxes are going to support. Again, maintenance—oh, there is the key to the situation. I refer in all of my criticisms to sand clay and clay sand roads. That is the only practical and feasible thing for our rural districts for the present at least, so my criticism will be on that class of roads. Now this question of maintenance—there is not a single county in the State of Georgia to my knowledge where a systematic provision is

made for maintenance and up-keep of the roads of Georgia. They go ahead with their initial work and then it all looks nice and smooth, but as I stated a while ago, the rain comes and here goes your expenditures of thousands and thousands of dollars for road work. I want this Congress to impress upon those men who have in charge the actual building of the road, the important fact that the up-keep is more important than the initial work. Now, Mr. President, what I want to see is a school to teach road builders of this country how to build a road; that should be the intent of your Congress. Create a school; they are ignorant, they don't know how to build a road, but they think they do, and won't come here to hear these experts tell them how to build a road. This expert knowledge is fine, I enjoy it. I am so intensely interested in good roads that I would like to hear it for a week, but it is just like the government aid to the farmers and the coöperative bank loans to farmers, it don't reach the man who is in distress. This expert knowledge that you are giving forth here in this convention does not reach the man who moves the dirt, you understand, the overseer, the superintendent. Let us have that kind of an education under State authority, if it is possible, and make it compulsory that he must bear a diploma from this school before he can accept a position as road builder in our country. Thank you.

MR. WILLIAMS: If the gentleman will present his name to the State Highway Commissioner of West Virginia, we will send him a copy of that kind of a law that is already in operation and doing good work.

THE CHAIRMAN: I think there can be no question but what the whole convention is with our friend from Georgia who has just spoken to us. The next paper is "Light Traffic Roads," by Mr. S. Percy Hooker, State Superintendent of Highways of New Hampshire.

SURFACES FOR LIGHT VOLUME MIXED TRAFFIC

BY S. PERCY HOOKER

State Superintendent of Highways of New Hampshire

In a subject of this kind the first question to determine is the exact meaning of the title.

What is light volume mixed traffic? How many vehicles are to pass over a given piece of highway and still be classed as light volume? What is their relative proportion as to motor propelled and horse drawn? I confess I am not clear upon the right interpretation of these terms. There are sections of the country where presumably the mixed traffic would consist almost entirely of horse

drawn vehicles, while in others a very large per cent would be motor traffic.

The treatment of the surface of these two sub-divisions would vary to a considerable extent. I am inclined to consider the subject as being the treatment of subsidiary roads which have only the horse drawn traffic originating upon the road, together with motor traffic of the pleasure class and little or no freight traffic which is motor driven.

From my point of view, the word "surfaces" is somewhat superfluous and the subject is the entire treatment, comprising the subgrade and drainage conditions, which must be considered as part of the surfacing in order to treat intelligently its surface.

I shall treat the subject, therefore, broadly as the improvement of the ordinary country road as it now exists. The purpose being to obtain the greatest amount of linear feet with the least expenditure of money.

With the immense mileage of roads in the United States, it seems to me perfectly clear that even in the wealthier States a large proportion of the roads will never be improved under the types of construction which are now considered necessary for their improvement and that 90 per cent of the entire mileage will be unimproved if it is necessary to improve them with the higher types of construction.

My impression is that there must be a revulsion of feeling which will compel more mileage and lesser cost. Given then a country highway as it now exists and the proposition that for 10 miles of this road there is only available the sum of $25,000, what can we do to render this really an improved road, which under proper maintenance will take care of the traffic upon it? A preliminary survey may show that a portion of the road is in a low lying level section without proper ditches where at present the natural tendency of the road is to act as a sort of drainage canal for lands adjacent to it. The soil itself consisting partially of leaf mold containing a large amount of humus and which if used as a cultivated field would produce good crops.

The next portion may consist of a sand and gravel formation, containing boulders and on a grade of from 5 to 8 per cent, rolling over elevations and down into hollows and gullies and eventually working out into clear deep sand.

Succeeding this may be a hollow from which you rise upon a side hill cut through a clay bank. Here you face the proposition that the clay is of such a nature as to practically absorb all the water and where your drainage condition is most difficult to handle.

Your last section may be through ledge of native rock or large boulders, the soil slightly covered with either hard pan or sand and upon grades which easily wash under the annual rain falls.

On almost all country roads several of these conditions will ordinarily appear, while of course it is an exaggeration that they will all occur within the 10-mile stretch.

Confronted with these conditions it seems to me to be absurd to attempt a standardization of such a highway in order to economically work out your problem. You must use the material which is comparatively local and the treatment of each section will be different.

The width of the present highway must first be taken up and in general standardized for the ordinary traffic, probably a width of 21 feet between ditches is the most satisfactory standard and considering that this should be accepted as the width of the road, you are next confronted with the alignment and drainage.

In all probability the alignment will be comparatively easy over your level fertile section, but the drainage on this section will be your principal problem. Here in general you must first provide by deep ditching for reducing the water level of the surrounding land and by deep ditching I do not mean the ordinary ditch from which the crown of your road rises, but in many instances a ditch which acts to a considerable extent as a drainage canal.

You must provide culverts at all points where the drainage may be taken away from the road at every accessible point, and however level you may consider the plain or plateau as a whole, you will doubtless find a large number of places by which the water will be conveyed entirely away from the road and bother you no more.

In most instances the grading material obtained from the ditches, though seemingly of very inferior quality, may be used to raise the general grade of your road and if kept dry by the side ditches will compact and make a fair subgrade.

Your next essential is in some way to obtain upon such raised grade a sufficient quantity of metal of some kind to prevent the cutting through of your road surface from water which falls upon the road or in flood seasons cannot be entirely carried away by your ditches. On my plan this may be obtained from either fields, stone fences or even drawn from section two, which has an entirely different soil. In some places it would be necessary to practically lay this stone as telford. In other places it is enough to simply dump it in the road and only partially place it by hand labor. In many places where a roller is available this may be the method and the stone simply forced into the soft material which you have excavated from the ditches and which has not as yet thoroughly dried out from the service rendered by the ditches.

Now what shall be applied as your surface material? In many places you will find that along or adjacent to the road there are hills or hummocks which contain soil not properly either hard pan or clay, but in many places a combination of each containing considerable metal in the shape of either pebbles or fractured stone, and having obtained your bottom through drainage and the addition of stone so that you are confident your sub-base will be practically dry, you may apply 10 inches of the material containing a small amount of metal and by the use of road drags and road hones bring

this first into section and next into a smooth hard surfacing, which will prove satisfactory in all weather for traffic, provided it has constant attendance and is repeated after every rain dragged with the ordinary road drag. The drag removes every slight rut which may be started and does not allow the water to settle through your weak upper surfacing. The maintenance must be not intermittent, but constant. You may find that you still have a somewhat slippery upper surface in which case it will be necessary to add an inch or two of your gravel or sand from section two. You will find that this will only require from 3 to 6 yards of your gravel surfacing per 100 feet and while it may be at a considerable distance from the improvement, it will not add materially to the cost.

Your surfacing upon such a type of road will require practically 2000 yards per mile and if the material is from different banks along the roads your cost will not exceed twenty cents per yard. It is then perfectly feasible over this section to build such a highway, including the raising of the grade from 1 to 2 feet at a cost of not more than your estimated limit of $2500 per mile.

On section two, as I have imagined it, you have a problem of grading, rather than of drainage. That is, the soil will readily dispose of your water, but you must reduce the grades to a reasonable gradient and with a sandy material provide some method for compacting the road. The first to consider then is what shall be your maximum grade.

I confess that in this class of construction I proceed backwards, like a crab, rather than attempting to dictate an absolute gradient. That is, I take the heaviest grade and see to which per cent I can reduce this with a reasonable amount of money, instead of saying arbitrarily that a 4 per cent grade is the maximum, I figure how much it will cost for a 4 per cent, how much less for a 5 per cent and what the saving would be, should I allow it at even a 6 per cent grade.

We will say that I have found that I may reasonably reduce the grade on this section to 5 per cent. This I establish as a maximum and the other grades are brought to this maximum.

There will doubtless be considerable blasting on the large boulders to do on this section in order to properly widen your road, because the ordinary country road has no established width. In cutting your grades you will usually find that a considerable portion of the material which you have excavated in reducing the grade makes good surface material and almost your entire expense will be the shaping of your roadway and your drainage.

As I have imagined it, however, as you approach the end of this section you have run through your gravel and into what is practically sand. Here the gravel that you have on the other end will not properly compact or pack so as to make a suitable road surface and you will have to build practically a sand-clay road. I have not had good success with the sand-clay roads, unless I have practically telfordized the same by making the sub-base largely of metal.

In my treatment of this particular part of section two, I should endeavor from the gravel pits used on the first part of it to obtain the small boulders sufficient to build the entire bottom of the road to at least 6 inches in thickness of such pebbles.

These I should fill with sand up to the top of the metal, then put on at least three alternating sections of clay and sand repeating until I had my road at least 10 inches thick, harrow each section as it is built up, seeing that the top surface is of sand rather than of clay.

This portion of the section, as I advise building, will doubtless cost much more than the sum per mile than you have expended upon the gravel portion, but together they should leave your general average within the limit.

Section three, consisting largely of grade, is almost entirely a drainage proposition and it will be very necessary to practically tap the water coming from the side hill near the surface or originating within the road. You may find it necessary in many instances to run short drains for the express purpose of tapping the water holes, which come up in the road bed proper and it will doubtless be necessary on the inside of such a road to lay a side drain the entire length of every grade. A ditch should be dug on the upper side of your road to a depth of at least below frost line, a foot of sand being placed in the bottom and then an open drainage tile laid to as perfect a grade as possible and your ditch filled in with sand seems to be the most satisfactory way of cutting off this water.

Having shaped your clay road which is a comparatively easy matter as such a road will retain its section and may be practically worked with a road machine and then covered with, not to exceed 2 inches, of sand and gravel harrowed in as thoroughly as possible, though it is somewhat difficult upon a clay road to get the sand to work into it at first and the farther application during wet weather of at least 2 inches more, will ordinarily give such a road a most desirable surface. The only caution being that you must not apply the sand in large quantities at a time, but must expect to renew this surface frequently during the first two years.

We have assumed that we have now come to the ledge and boulder section and that all material must be drawn from a considerable distance to make a satisfactory road. Here without question, the most feasible plan is to use a macadam roadway. The putting up of a local crusher and the macadam method of construction may enable you to build at a less cost than would the use of the uncrushed material.

Frequently, however, on such sections there is a great difficulty in getting sufficient water to properly flush a water bound macadam road. You may obviate the use of large quantities of water by the use of bitumen but this adds greatly to the cost of your road.

Wherever macadam is used you may retain the same 21-foot section, though 15 feet should be the extreme width of the metalling. This will take 2600 tons per mile of stone and assuming the use of

2¼ gallons of bitumen per square yard, your added cost will be something over $2000 per mile. If water is fairly available, you may build your water bound road and apply one-half gallon per square yard of bitumen as a cover coat at a cost of about $650 per mile, which will reduce the cost of your road for light traffic about $1500 per mile. Unless there is considerable trouble about getting your water therefore I should recommend the use of water bound macadam with the blanket coat.

You must consider also the added cost of maintenance upon your macadam road as compared with the cheaper forms, so that personally I should hesitate about using macadam whenever there is a possibility of using the cheaper surfacing.

Assuming a small apportionment available for the entire mileage needing improvement the economic question is what plan will you adopt for the treatment of such a highway. Will you practically complete this 10 miles with your money or will you build 3 miles of the higher type of roadway and leave the rest unimproved. This seems to be the attitude adopted by most highway departments. They standardize their plans and specifications and are content with the small mileage of what they are willing to say is the best construction and they dislike extremely to build for small cost what they term an inferior type of road.

I believe this is a serious economic error and in most sections a road infinitely better than has previously existed may be built at a comparatively small cost to the great betterment of the roads in general and to the great help of the inhabitants of a State.

As far as automobile traffic is concerned, I am sure that many of the inferior types of road are far more satisfactory to them in general than the highest type. Your autoist cares little for a short section of the best possible road if at the end of it he plunges into what he is pleased to call an impassable road for three-quarters of the distance. I believe the development of roads in the future will be along the line of more mileage and less cost and that this is the proper trend of development.

I have talked so far almost entirely about the preliminary building of such surfaces. I want to say a little about the cost and methods of maintenance on these types of road.

Constant continuous maintenance is necessary upon all the types of roads that are built. It is indispensable, however, that upon the surfaces of the cheaper type of roadway the maintenance be both continuous and intelligent.

A road of what may be called natural surfacing, if left for even a week during the summer season without attention loses all its features of a good road. It must be constantly patrolled, all holes in it which have worn must be filled, all weak spots which develop must be repaired within a few hours after discovery or your road will so rapidly degenerate that it is useless as an "improved."

The higher types of roadway may be left for varying periods of time without attention and while this results in the end in being a more expensive method of treatment it is only a loss of money, you still have the road which may be repaired, but if you attempt this sort of treatment upon your cheap surface you eventually lose your highway entirely.

My experience is that a patrolman with a horse and cart, an efficient drag or hone and the willingness to work will keep in almost perfect condition from 5 to 7 miles a cheaply constructed roadway, at an approximate cost of from $175 to $200 per mile.

Given the same mileage of the higher types of road he will require a helper, a much larger equipment and if working upon bituminous roads probably not less than $150 per mile for material in the way of bitumen, crushed stone, etc.

My average cost of maintenance upon the higher types of road including the use of a blanket treatment once in two years will not be less than $500 per mile, and in many instances it will greatly exceed this. On the expensive road also you are constantly facing the fact that within a reasonable number of years you must resurface at a cost approximating $6000 a mile, while upon your cheaper road, if properly patroled, you will find that your surface material is thicker than it was at the time the road was built and has been in practically perfect condition during the entire period.

If the dust nuisance upon your cheaper road becomes intolerable it may be alleviated greatly and practically removed by the application of light bituminous oils or tars. The objection of this treatment, however, being the tendency on the part of a patrolman to allow the road to get out of section by neglecting to drag it after every rain, as he does not wish to destroy the skin coating on top, which is left after the treatment.

The cost of this treatment adds about $150 per mile to the cost of maintenance and on the whole is not as satisfactory for light travel in its final results, as adhering to the use of the natural soil and the regular treatment by dragging.

Road problems may be roughly divided into four sub-divisions, and their order of importance is about as follows; drainage, alignment, grade and surfacing.

It is unfortunate that to most people the latter is more important, while relatively it is of far less importance than the other three. The surfacing material is frequently considered paramount and the settling of the question as to whether you have a bituminous road, penetration method or mixing, a concrete road, or a pavement type is the main subject of discussion and with far more attention given to it, than in my opinion it rightly deserves.

Your drainage, alignment and your change of grade are permanent features. The surfacing can never be permanent. I have sometimes wondered whether a bond issue to be paid for by posterity should ever be expended on any feature that is not permanent.

Concededly, surfacing of all kinds will require not only constant maintenance but rebuilding. With the essentials fully attended to it is surprising how the surfacing may be maintained at a comparatively small cost. I believe that it is as necessary for us to turn our attention to the economic side of the road question as to the scientific. A highway must have an economic road rental, as well as a fixed road maintenance and wherever the actual cost plus its maintenance exceeds its rental value we are wasting money in building too expensive a road. We must so adjust the scales that our costs are such as to provide a roadway for the traffic at the least possible expense.

I realize that this is a very sketchy treatment of the subject given me. It is not scientific, but it equally is not theoretic. Financial problems in a State with a very small assessment roll and a large road mileage has made it a necessity in my State.

In order to accommodate a large tourist traffic we must have reasonably good roads and we cannot afford the kinds of roadway that are being built in many of the richer States. We have met the problem, as I have outlined in a rambling way, and it is satisfactory to us. It seems to me that there are many other States which might well adopt a plan of more mileage at less cost to their great financial benefit and to the comparative satisfaction of their residents and visitors.

THE CHAIRMAN: Before taking up the discussion of this subject, I want to announce that the Resolutions Committee will meet at three o'clock today in the second floor front room of this building. I also want to announce that there will be a meeting of State highway officials and Federal highway officials in the moving picture room across the hall at three o'clock tomorrow. The discussion of this paper will be opened by Mr. Frank F. Rogers, State Highway Commissioner of Michigan.

MR. ROGERS: *Mr. President and Gentlemen:* I am almost without any underpinning here, because I had prepared to discuss the very paper that was written out so carefully by the speaker who has just preceded me, but inasmuch as he did not give you any of that paper, I am at a loss to know exactly what I am going to discuss but I have it all written out before me. Well, I don't know but I will take a little different view of the subject from that of the man who preceded me because I do not assume that the people who are before me all represent this territory around Atlanta. I have seen men on the platform from Washington and from Kansas and from New Hampshire and Pennsylvania and I assume that this subject is to an audience somewhat farther reaching than the territory that is affected by the roads about Atlanta.

I don't know much about road conditions except in Michigan

where I have been connected with the system for several years, but as Michigan is somewhat typical of the States of the Central West, I am going to give you a few of the problems that have occurred to us and if any of this becomes wearisome, I can cut it short.

The few traffic records that we have taken show that the travel over Michigan roads has a daily average ranging from something over 2000 vehicles per day down to a very few, say less than 10. Our traffic records also show, as have those taken by other States, that the volume of traffic drops off very rapidly as the distance from the market town increases and that on the main or trunk line roads, the minimum traffic is found approximately midway between the towns, or more correctly, where the effort to reach a given town meets with the least resistance.

To illustrate, the main roads entering the city of Detroit bear a traffic near the city limits ranging from 500 to 2000 vehicles per day, of which from one-half to three-fourths are motor driven.

The travel on the main roads entering the city of Lansing, a town of approximately 40,000 population, ranges from 200 to 600 vehicles daily with about the same percentage of motor vehicles. Michigan Avenue, which is the main road entering Lansing from the west and on the main line of highway towards Detroit, bears a traffic according to a count taken one-half mile from the city limits, of 600 vehicles per day. This road connects the city of Lansing with East Lansing, which is really a suburb of Lansing, and the home of the Michigan Agricultural College. One mile east of East Lansing on this same road, the traffic drops to 300 vehicles per day, and eight miles from Lansing on the same road and about one mile east of the little village of Okemos, the traffic drops to about 125 vehicles per day, which is considerably less than on any main road entering Lansing at about one mile from the city limits.

From the foregoing I am inclined to believe that roads having a traffic of less than 300 vehicles per day might consistently be considered as coming within the scope of this subject, and I wish to confine my remarks chiefly to roads of this class which have come under my observation.

In 1906 the Michigan Avenue road between Lansing and East Lansing, some two miles in length above referred to as carrying a traffic of 600 vehicles per day, was surfaced with water bound cobblestone macadam. It immediately began to ravel, especially midway between the two towns, due to the fact that it became a speedway for automobiles, as it was then the only improved road leading out of Lansing. The second year a contract was let to the ———— Refining Company to improve this road by incorporating a bituminous binder. The road was scarified and a rather light asphaltic oil added and re-rolled with a hope of binding the road. The oil did not prove a good binder and the road soon became rutted and uneven, so that it was even in poorer condition a few months after treatment than before. As this road was put in under a two

year guarantee, the next year the company scalped off the old bituminous surface with a thin layer of stone which adhered to it, and carted it all away. The road was then scarified and more bituminous material with greater cementing qualities added, after which the road was surfaced with about an inch of screened gravel and rolled. This seemed like a fairly good road for a few months, but the binder was sticky in warm weather and while the road appeared smooth, the adhesion of iron tired vehicles to the road surface made traction heavy rather than light. Later this road became very much rutted and was in poor condition and during the fall of 1913 it was decided to give the road a screened gravel top.

The bottom layer of gravel about four inches thick, loose measure, was applied to the road in the fall of 1913 and allowed to work down under traffic during the winter and spring months. In the spring of 1914 another layer of screened gravel was added which was harrowed and rolled, but mainly compacted under traffic. After the road had become fairly hard, it was treated with two or three applications of gluterin. The road surface remained in a smooth and firm condition most of the summer, but at this writing, November, 1914, the road crust is breaking at points and for quite long distances the surface presents a series of pit holes at quite uniform distances of about one foot apart, measuring along the axis of the road.

The above facts have convinced the writer that roads having as much traffic as the above, cannot be held up with water bounded macadam nor even with the best gravel surfaces, unless they have constant repairs. It would doubtless be wise to pave such roads with cement—concrete, asphaltic concrete, or brick.

Still further analyzing the traffic on the above road and rating single horse vehicles at one-half ton, double team light vehicles at 1 ton, double team loaded vehicles at 2 tons, runabout automobiles at 1 ton, touring cars at 2 tons, and motor trucks at 4 tons, the above road was found to have 225.6 tons per yard of width per day, or counting 300 days to the year, 67,680 tons per yard of width per year.

Engineer J. A. Brodie of Liverpool, who has carefully recorded his experience with the different types of road surfaces, places the total life of water bonded macadam roads at 120,000 tons, which would indicate that this road as originally built and under the traffic it now bears should not have been expected to last even two years. But this is really a heavy traffic road and does not properly come within the limits of this discussion except for comparison.

The next road out on Michigan Avenue, between East Lansing and the village of Okemos, already referred to as having a traffic of 300 vehicles per day, has a length of two and one-half miles. The westerly mile of this stretch of road on which the traffic count was taken, was built in 1908 as a 9-foot gravel road at a cost of $1800.

The soil composing this road is a sandy loam, sufficiently rolling for good drainage. The road grade was built 20 feet wide between gutters and the central portion of the road was surfaced with 9 feet of gravel put on in two layers, and in sufficient quantity to make 8 inches of compacted depth. Each layer was harrowed and rolled separately. The gravel was of good quality, the pebbles all being fragments of the harder rocks. The surface layer was coarse enough so that from 60 to 70 per cent would be retained on a No. 8 screen. No extra binding material was added and although the gravel was harrowed and rolled, it was mostly compacted by traffic. This road has been used without resurfacing or repairs, except in spots, and there with a poorer quality of gravel than was used in the original construction, but it has been in need of resurfacing for about two years.

The road above referred to was so good and satisfactory to the users, that the writer has been asked many times why a road like this was not built between Lansing and East Lansing instead of the macadam. Of course these parties did not realize the difference in the amount of traffic on the two roads.

The point I wish to emphasize regarding this road is that it was built of local gravels and was very low in first cost, but served the needs of the community perfectly for from three to four years with but very little expense for maintenance.

While I have no data from other sources stating how many tons of traffic such a road should carry per yard of width during its life, this road has carried according to the same rating as used above, 175 tons per yard of width per day, 52,500 per year, or during the four years in which it was in relatively good repair at small cost, 210,000 tons per yard of width, or one and three-fourths times as much traffic as Mr. Brodie figures for a water bonded macadam. Sixty-six and eight-tenths per cent of the travel on this road has been motor vehicles.

The road beyond Okemos on which the count was taken is an ordinary earth road and will not be further considered.

One other road will suffice for these illustrations. It is a 9-foot gravel road built on the Grand River Road in Farmington Township, Oakland County, in 1910. It was resurfaced on account of becoming a part of the trunk line, in the fall of 1913, although it was not in bad condition at the time of resurfacing. The traffic record shows this road to have carried 195 tons per yard of width per day, 58,500 tons per yard of width per year, or during the three years, 175,500 tons per yard of width in the three years before it was resurfaced. This again is nearly one and one-half times as much as the water bound macadam was rated at by Mr. Brodie. About three-fourths of the traffic on this road was from motor vehicles. The cost of building it was reported as $2524 per mile.

I have not given these illustrations for the purpose of showing the superiority of gravel roads over macadam, or in fact over any

other type of road, for Michigan is using almost every kind of roa building material available and is especially trying to make th best possible use of the materials near at hand. They are given however, to show that well built gravel roads are actually standin up under a mixed traffic of farm vehicles and automobiles as wel if not better, than we could hope to expect. Further the cost o these roads where good gravels can be had within a wagon haul is very reasonable, and since the total cost of a road to a communit is its first cost plus maintenance, the total cost of these roads is no great.

To show that such roads are not exceptions, but that they actuall are being built in Michigan for approximately the figures given, am taking from a table of costs which will be printed in the forth coming report of the Michigan State Highway Department, th average cost per mile of 9-foot gravel roads, from a number of coun ties representing different sections of the State. They are as follow

Allegany County	$1,643
Antrim County	3,942

In this county the grading cost is rather heavy and the grave was all screened.

Barry County	$1,855
Benzie County	2,154
Calhoun County	1,805
Clinton County	1,983
Eaton County	1,725
Genesee County	2,577
Gd. Traverse County	2,833
Hillsdale County	2,142
Huron County	1,961
Kalamazoo County	2,414
Oakland County	2,426
Roscommon County	2,091

The above figures are sufficient to show that quite generally ove Michigan, we are building roads of a type that seems to satisf the needs of the different communities at a cost somewhat withi the $2500 per mile limit assumed by Mr. Hooker as a fair figure t expend on roads carrying a light volume and mixed traffic. I fact, 64 per cent of all the roads which have received State aid i Michigan are of gravel. It may be argued that these 9-foot grave roads would not serve the needs of most communities. Michiga has demonstrated to the satisfaction of her own people that the do in most cases. In making inquiries regarding the width of mets track several years ago, the writer asked a certain highway com missioner in Michigan if there were complaints of his road bein too narrow, since it was completed. His answer was: "It is a goo deal like this: All the time I was building the road everybody wh came along said it was too narrow; after it was completed, every body who came along said it was too short."

While Michigan is building many roads with surfaces wider than 10 feet and pays extra bounty for extra width of metal surface between 9 feet and 16 feet, the greater number of light traveled roads are still built and will continue to be built with the metal only 9 feet wide. Experience shows that where the travel is relatively small, probably less than 100 vehicles per day, the shoulders of the road soon grass over up to the edges of the metal. In other words the turning out is not frequent enough to keep the grass worn down on the shoulders beyond the edges of the 9-foot metal track.

So long as the cry is for more distance rather than for more width, it is probable that Michigan will continue to reach out and have for its slogan: "Put it on the ends rather than on the sides." It is clearly the duty of the road engineer to make every dollar placed in his hands for road building purposes, give the people the utmost value in actual road service. If a gravel road which serves the needs of the community can be built for $2000 a mile and can be maintained, including periodic resurfacing at a cost of $200 per mile a year, thus representing to the community a perpetual annual rental cost of $300 a mile, money being worth 5 per cent, it would seem to be folly to build the more expensive road unless traffic or soil conditions demand it. If we expend $10,000 a mile on a road, even if there were no maintenance charge, the annual rental cost of such road will be $500 per mile. But the expensive roads do come to repairs sooner or later and these repairs are likely to be at about the same ration as was found in the original cost of the two roads—1 to 5.

If the daily traffic over these roads is 100 vehicles a day, the perpetual toll cost of the cheaper road will be one cent per mile, while on the more expensive road it will be $1\frac{2}{3}$ cents per mile, plus the maintenance charge, which will make a toll charge much more than double that on the cheaper road, the volume of traffic remaining the same.

But as already said, Michigan is not tied to any one type of construction. This is clearly shown by the different classes of roads already built. At the close of the last fiscal year, June 30, 1914, there had been completed 2437 miles of State rewarded roads in Michigan representing the following classes: $52\frac{1}{3}$ miles of sand-clay or thin gravel roads; $1{,}570\frac{1}{3}$ miles of standard gravel roads; 77 miles of macadam base and gravel top roads; 23 miles of gravel base and macadam top roads; $647\frac{1}{3}$ miles of macadam roads, mostly plain and water bonded; and 67 miles of concrete roads. It will be noted that most of these roads are suited only to light volume traffic and when it is considered that the average cost of all classes is not far from $3000 a mile, it must be admitted that Michigan is not in danger of the re-action against the high priced road mentioned in Mr. Hooker's paper.

November 11, 2 p.m.

MR. JAMES H. MACDONALD IN THE CHAIR.

THE CHAIRMAN: The convention will please come to order. I want to make a little apology for sounding the gavel 26 minutes past two, when the meeting was supposed to be called to order at 2 o'clock, but the fact is there was no one here just promptly at 2 o'clock; we have grown into the habit of being just a little tardy and while the machinery is helpful in the highest degree in road building, in my judgment these sessions are more important than the machinery end of them. I find myself, ladies and gentlemen, somewhat embarrassed; I had expected to deliver a talk on the past and present and future, in other words, yesterday, today and tomorrow in road building, but I had not learned that I was to preside over the session. So it rather embarrasses me, having sat sometimes in my little life at a banquet where I was a speaker and having the toastmaster introduce the next speaker at length and then interlard or extend his remarks; that was a very uncomfortable place. At the same time I feel that in justice to the delightful hospitality which has been extended to us here, that I ought to say something in appreciation. To me this is a singularly pleasant opportunity to be here in Atlanta. Forty years ago my little wife and I made a visit here and as we looked the situation over, the streets and the air of inactivity on every side with practically only three streets that made any pretention to being streets, Decatur, Marietta and Peachtree Streets; I come back here after 40 years and I see the little people of 15,000 have grown to a multitude, 200,000; I find the little hamlet of houses have been supplanted and been added to, not only the delightful homes of the people but the magnificent structures on every side. I have travelled at home and abroad in this great work. I have never seen anything to equal the growth that is so manifest as it is to me here in this city of Atlanta. The delightful hospitality extended to the wife and myself will always remain as a pleasant memory to both of us. So it is a great delight to come back here and to go through the scenes which are so vividly impressed on our minds as the sweetest part of our lifetime, the early memories, and live over again those days. I am happy to say we have with us today President Harrison of the Southern Railway Company. He is acceptably filling the position occupied by Mr. Finley, he is on the Executive Committee of this great Association. He has been an ardent good roads man for many, many years. The great question of transportation appeals to him very closely and we are glad to have him with us today. He is destined to be, if I may prophesy from the point of view of intimate personal knowledge, one of the greatest railroad authorities we have in this country, and this convention is highly honored when we have such a man as President Harrison to speak to us on this great question today. I take great pleasure of introducing President Fairfax Harrison.

SELECTING ROADS TO BE IMPROVED

By Fairfax Harrison

President, Southern Railway Company

In the early days of the good roads movement, a meeting such as this in the South would properly have devoted its time largely to emphasizing the advantages of good roads, but, while educational campaigns to teach the value of good roads are no longer needed in the South, the holding of the American Road Congress in Atlanta will tend to stimulate the good roads movement in all of the southern States. As soon as the present business depression, growing out of the effect of the European war on the market for cotton, has passed away, as it surely will, and when the onward progress of the South has been resumed, one of the ways in which it will be manifested will be in greater activity in road building.

When road improvement is taken up in any community, it is important that it be started right, and I shall venture to speak to you briefly on what, I think, is one of the most important matters that must be decided before actual work can be commenced. That is: the selection of the roads to be improved.

It is almost invariably true that the community embarking on a policy of highway improvement is not financially able to rebuild all of its roads at one time. Those in charge of its road policy must decide which of the roads shall be improved at once and which shall be left for the future. The answer must be found in the peculiar needs of each community.

There is a glamour about the mere suggestion of a great through highway traversing several States, connecting widely separated cities, and traveled by tourists from distant parts of the country. The very history of such roads is fascinating, as, for example, that of the Cumberland road or the national highway which pierced the West in the early days of the nineteenth century. Under modern conditions such a road may benefit the owners of touring cars, and its use by them may scatter some few dollars in the different communities which it traverses, but it will benefit relatively few farmers —only those who live along its line. In a community where the principal industry is conducting hotels for tourists, the improvement of roads with special reference to attracting automobile travel may be desirable, but, generally speaking, I doubt whether the best use that can be made of a limited road fund will be in the construction of a through highway of this kind.

The statesman of road building must consider what permanent value the road may serve in developing a country, and under our conditions in the South this consideration points inevitably to the farmer as the class most to be considered in road planning.

A good country highway is helpful, directly or indirectly, to all those who live in town as well as those who live in the country,

but it is primarily beneficial to the farmer. It is his highway to market. He and his family must use it in all of the social intercourse of the neighborhood and in church and school attendance. It is over the country road that the rural mail carrier brings to the farmer his letters and the newspapers which keep him in touch with the events of the world. While it is not generally appreciated, because few farmers keep books in which they take account of their own time and that of their teams as well as of their hired men, statistics prepared by the United States Department of Agriculture show that the cost of hauling farm products to a shipping station is a very large percentage of the total cost of their carriage to their final markets and is out of all proportion to the charges made for their transportation by rail or water. An improved road reduces this cost and has the effect of bringing outlying farms nearer to the shipping point by reducing the time required for hauling, and it tends to advance the value of each farm that it passes.

On account of the great interest of the farmer in good roads, I believe that those responsible for the road policy of any community should endeavor to expend such funds as may be available so that the largest possible number of farmers may be benefited and that this may be accomplished by improving first the roads that radiate from a market town or shipping station.

If the amount of money available is quite small, it may be necessary to limit expenditures, for a time, to a single road, but where sufficient money can be obtained, the benefits will be more widely distributed if the money can be expended on several, or all, of the important roads radiating from the town. While it is possible that, on a given road, the greatest benefits will be obtained by spending the money that may be available for it in improving some particularly bad part of the road at a distance from the town, the general policy, I believe, should be the improvement, first, of that part of the road leading out from the town. If the policy of dividing the money available among several roads rather than concentrating it on a single road shall be adopted, it may not be practicable to improve an extended mileage on any one of the roads. This will, however, permit the largest number of people to share in the benefits, for the farmer driving into town from any direction, even though he may live beyond the end of the good road, will have an improved highway for at least part of his haul to town. Then, as additional funds become available, from year to year, each of these roads may be extended further into the country, until, in time, they form connections with similar radiating roads constructed by other communities, and the entire locality is provided with a network of good roads.

While a system of radiating roads of this kind will benefit the farmer primarily, it will also be helpful to the town. In an agricultural community, without substantial manufacturing enterprises, the town is practically supported by the trade of the farmers of

the surrounding country. A good road, to the degree that it may enable a farmer to market to better advantage, increases his purchasing power to the benefit of the merchants in the town where he may trade. Improved highways radiating from a town widen the area from within which the farmer may profitably market his products and buy his supplies in the town. Good roads in any community are also an important factor in attracting farm settlers, who will bring increased trade to the town.

But we have in the South many purely industrial towns and cities which may seem not to depend largely on any back country—towns in which the trade of the surrounding farmers is relatively of little importance in the total volume of their business. Such towns are nevertheless interested in developing systems of radiating roads such as I have suggested. Even in the largest city, a certain element of the population is concerned, directly or indirectly, in the trade of the surrounding country and every resident is almost as much interested in building up nearby sources of cheap and fresh supplies for his produce market as he is in the maintenance of good schools. With bad roads that are almost impassable during certain seasons of the year the area within which milk, and perishable articles generally, can be successfully produced for the city market, is restricted. With improved roads this area is greatly extended. A system of good roads out of a city may mean, for a large part of the population, the difference between fresh food and the cold storage warehouse.

I may emphasize the point I am endeavoring to make by citing the concrete example of Mecklenberg County, North Carolina. That county was one of the first in the State systematically to take up the matter of road improvement. The United States census reports show that in the twenty years from 1890 to 1910, the population of Mecklenberg County increased 57 per cent, as compared with an increase of but 36 per cent for the State of North Carolina as a whole, and the population of Charlotte, the county seat, increased, in the same period, 194 per cent, a more rapid rate of growth than was shown by any other incorporated place of relatively the same size in the State. The value of all farm property in Mecklenberg County in 1910, as reported by the Census Bureau, was greater than in any other county in the State with the exception of but one county with one and three-fourth times the area of Mecklenberg County, and the value of farm lands, per acre, was greater than in any other county in the State with a single exception. Other factors have contributed to the progress of Mecklenberg County, but we may fairly attribute part of its growth in population and wealth to its enlightened road policy.

Other southern counties might be cited showing similar progress following the construction of improved country highways radiating from a central market town, and I believe that, wherever this policy may be adopted, its wisdom will be demonstrated by results.

A MEMBER: We have with us this afternoon another president of a great railroad system who has taken a great deal of interest in good roads all over the country; I refer to the President of the Nashville, Chattanooga and St. Louis Railway. This gentleman is known and loved and trusted by the people of the South and I feel sure we will be glad to have a few words from Mr. John Howe Peyton, President of the Nashville, Chattanooga and St. Louis Railway.

MR. PEYTON: I feel that this is an imposition because it is breaking into the program of the afternoon, and I will have to ask to be excused. I would like to express my hearty and sincere sympathy with the work that you are promoting and my desire to assist in pushing it forward. I feel that I would be imposing on your good nature to further interrupt the program.

THE CHAIRMAN: No, I think not; come right up and we will be glad to hear you.

MR. PEYTON: *Mr. Chairman and Gentlemen:* I must repeat what I have just said from the floor, I am afraid I am imposing upon you in thus breaking in on an admirably arranged program.

Since, however, you have been so good as to insist on my expressing my views as to the work you have in hand, I am glad to take advantage of the opportunity.

My enthusiastic and most worthy friend, Mr. Meyer, of Carthage, Tennessee, is doing splendid work in his State as a leader in moulding a public sentiment favorable to the construction and maintenance of good highways in Tennessee. I am heartily in sympathy with him and shall try to hold up his hands and assist him in such efforts.

Mr. Harrison, who has just preceded me, and has read a most able paper in your hearing, modestly states that he is not an engineer or constructor and therefore not in position to discuss details of good roads either as to construction or maintenance. You may be interested to know that before I became president of the Nashville, Chattanooga and St. Louis Railway I had been, for thirty-two years, in the active practice of civil engineering.

I am therefore not only deeply interested in the matters that you have met here to discuss but fairly well equipped to assist you.

I am persuaded that the agricultural interests of our country are paramount in importance, but that successful and progressive agricultural development is not possible without adequate provision for transportation by means of good highways from the farms to the railroads and good and efficiently managed railroads leading thence to the markets.

Being thus persuaded, and being devoted to my country, I am doing all in my power to promote scientific agriculture; good highway construction and maintenance, and good railroad construction and operation.

I came here seeking information that may make me more efficient in furthering the highway projects in my State.

I thank you heartily for giving me this opportunity to look you in the face and now I am going to listen most attentively to the papers that are to be read by the gentlemen whom you have selected as most competent to instruct us.

THE CHAIRMAN: There are many questions that come up for our consideration in road building, but there are no questions that have come up to disturb the commissioners more than to take care of this great question of the heavy traffic roads. Of course we know that the macadam road will wear out and the gravel road will wear out, the brick road will wear out and indeed the great presidents of these railroads will tell you that they have never been able to put that little piece of rail down yet but what they had to be replaced. I have sometimes thought that there is nothing in this world but what will wear out except perhaps it might be the mercy of God, and that is sometimes severely tried. One of our citizens happened to go through Maryland, and we are pretty proud of our roads up in Connecticut and think pretty well of them and I want to tell you that it is not with any feeling of envy or jealousy that I relate to this convention what he said to me, for I served Connecticut 18 years as commissioner. He said, "Mr. MacDonald, I never rode over better roads since I have been on that car, and it has been a good many years, than I rode over in Maryland." We have with us today a gentleman who assisted materially in bringing about that condition of affairs, Mr. Henry G. Shirley, and I take great pleasure in introducing him.

HEAVY TRAFFIC ROADS

BY HENRY G. SHIRLEY

Chief Engineer, State Roads Commission of Maryland

The rapid change that has taken place, and which is daily taking place in the character of traffic on our highways, makes the selection of the type of surface more difficult each day for the highway engineer. In selecting a type of surfacing for any particular road, the engineer not only has to study the amount and kind of traffic that daily passes over the road, but has to make a very comprehensive study of the amount and kind of traffic that will probably pass over the road in the future, by virtue of the development of the surrounding territory on account of the improved road.

The writer has made studies of roads where the traffic, before improvement, consisted of light vehicles and nothing heavier than two-horse loads, but as soon as the road was reconstructed, the amount of traffic increased from 50 to 300 per cent, and the loads from light two-ton loads to ten to twelve-ton motor trucks, and

fourteen to eighteen-ton tractors. He also recalls constructing a section of road through a very sparsely settled section, and estimating that it would be quite a long time before the adjacent territory would be more thickly populated, and accordingly selected a soft local limestone for the metal surfacing, but which had sufficient strength and hardness to carry the traffic that was passing over the road at that time. Scarcely had the road been completed when several large tracts of woodland, not a great distance from the road, were cut down, and the lumber was transported on wagons, drawn by large traction engines with cleats, over the road to the railroad station. The effect of this heavy traffic on the soft limestone surface can be easily surmised.

Drainage of a road-bed that is required to carry heavy traffic, should be well taken care of by tile or other sub-surface drains, so as to render the sub-foundation as dry and firm as possible. The maximum grade should not exceed a 6 per cent, and the alignment should be as straight as possible, with all sharp curves and bends eliminated. The width of the roadway and the width and thickness of the metal surfacing should be designed to meet the requirements of the present as well as the future traffic which it will have to accommodate, but the minimum width should not be less than 30 feet, nor the metal surfacing less than 18 feet. Broken stone or gravel make a fair foundation, but concrete is almost as cheap and is more preferable.

The thickness of macadam and gravel should not be less than 5 inches after rolling, nor more than 10 inches, while concrete should not be less than 4 inches, nor more than 8 inches, depending primarily, upon the character of the soil of the sub-base, and the intensity and character of traffic it will have to sustain. In some cases where the loads are very heavy, but the number of loads small, it has been found economical to lay a strip of high-class and durable pavement in the middle of the road for a width of 9 to 14 feet, with a cheaper and less durable material on each side.

Before selecting the type of pavement to be used, a close and accurate census of the different kinds of traffic should be taken, a very thorough study made of the surrounding section, and an estimate made as to the possible increase of the different kinds of traffic, or the decrease of one kind and the large increase of the other. It is the opinion of the writer that in no other line of engineering should there be a larger factor of safety used than in estimating the amount, intensity, and kind of motor and self-propelled traffic that will pass over our improved roads in the near future. The great change in the character of traffic developed in the past five years, is but a small index to what can be expected in the next five years to come.

The types of pavements used on heavy traffic roads should be selected as to their fitness to stand the kind and intensity of the traffic that will travel them. Roads in the outlaying districts, where horse-drawn traffic comprises the larger percentage should be constructed of macadam with a light surface treatment. Concrete will

also be found serviceable and desirable. Where motor traffic is in the majority, bituminous macadam or concrete will give good results. Near the centers of population, where the traffic is mixed and heavy, concrete, bituminous concrete, asphalt or vitrified brick will prove the most economical. Where the heavy traffic is concentrated, brick, asphalt or stone block are the most suitable.

There can be given no hard and set rule for selecting the type of construction that should be used on a given section of road to carry a known traffic. For local conditions, the availability of materials, etc., play such an important part in the selection of the type of surfacing in any locality, that each individual case must be worked out on its own merits.

The following method of selecting a type of surfacing to carry an estimated traffic, however, will prove fairly accurate where a study can be made and the maintenance cost can be had of roads constructed and maintained under similar conditions:

Where the annual cost of maintenance of a less durable type of road surfacing will exceed the annual cost of maintenance of a more durable type of surfacing, plus 4 per cent on the excess cost of the more durable type over the less durable type, the more durable type should be used, and vice versa.

The maintenance on heavy traffic roads should be continuous and thorough—never allowing the surface to remain broken any length of time, but as soon as the slightest defect or indication of failure appears, it should be speedily repaired.

The writer cannot close this paper on "Heavy Traffic Roads" without calling the attention of the Congress to the great necessity for having adequate laws to regulate the heavy loads that have to be borne by the surface of the many hundreds of miles of roads that have been and are daily being constructed. The manufacturers of tractors, motor trucks, and other hauling engines, have given but little study to the effect and injury that is being done and may be done by the heavy loads propelled over the road surface, and the strain and stress caused by narrow tires, steel cleats, ribs, and other devices, but it seems that the greater amount of their energies have been to develop an engine or motor truck that will haul the largest load in the shortest period of time, using the least amount of fuel—all of which is very commendable, but it is the duty, as well as to the welfare of these manufacturers, to devote quite as much energy and brains in constructing their engines and motor trucks in such a way that the least amount of damage will be done to the surfacing in passing over the roads. It is most important that the manufacturers of hauling equipment and highway engines should work together in framing a set of adequate laws controlling the use of hauling equipment over improved roads, as well as developing wheels and other devices so as to do the road surfacing the least amount of damage. By coöperating and working together, large sums can be annually saved on maintenance, which will greatly benefit all concerned.

THE CHAIRMAN: I think that if the title of this address had been changed to read "What is the Best Material to Use Upon Heavy Traffic Roads," that quite a number of gentlemen who are out here selling material would have been in the hall and would have filled it up. I remember one time hearing a man say that if people would buy one of his grates they would save half the coal, if they bought two they would save all the coal and if they bought three of his grates they would have coal to sell. We are going to have this discussion opened by a gentleman who is Superintendent of Public Works of Fulton County, Georgia, Mr. William A. Hansel, Jr. Those of us who have been privileged to go out here in Fulton County and see the splendid system or roads that he has developed and know that this has all taken place within the last 15 years—I want to tell you it has been a stupendous operation, and under the condition which he had to contend with, this red mud of Georgia, he has solved a difficult problem. He has built the roads not only where the people live but where the people are going to live in these little isolated places, and it is a pretty good lesson for all of us commissioners who have had to do with this great question for so many years. I take pleasure in introducing Mr. Hansel.

MR. HANSEL: It is but just to my predecessor in office to state that the good words the chairman has spoken about our roads are not due to me; I have only been with the county a few months, while my predecessor has been with the county 27 years and most of the good work is his and not mine. However, I hope to continue the work he has started. Mr. Shirley has so covered the subject that I shall have no opportunity to bring out new points but I would like to particularly emphasize some parts of his paper. The first thing is, of course, to make as thorough a study of the traffic conditions as is possible, with a comprehensive investigation as to the materials locally available and the ability of local labor to use these materials. After this has been done the road selected must be the one that best serves its purpose and whose cost stays within the money appropriated for its construction. Quite frequently we are obliged to put down what we know is not best, because the money for the proper construction is not available. It is sometimes possible to get a good road by putting a narrow strip of expensive material in the center and paving with less expensive material on the sides. It is much better to have 12 feet of good road and a cheap gutter than a cheap road the full width. A rubble side pavement costs very little and if given a finish of cement grout makes a very good substitute for an expensive road. You can see this being put in on the concrete road now under construction here. A plain macadam road is a fairly good road and if given a surface treatment of road oil or some similar coating it is much improved. If the road indicated is macadam it does not cost much more to make a penetration bituminous macadam or a concrete road and either

uch better. If you have more money to spend, a mixed method minous macadam is still better or using a concrete base, asphalt, k, wood block or granite block. Where the money to be in- ed is little, heavy traffic can be cared for by sand-clay and top roads if the maintenance is continuous. Where a pavement on a concrete base is indicated, it would usually be cheaper to e the entire pavement of concrete and with the present rich tures very satisfactory results are obtained. Whatever the road, very necessary, after taking care of drainage, to see that all hes are properly refilled and tamped from the bottom up. Too uently an otherwise splendid job is marred by the sinking in ditch and the accompanying bad place in the pavement. It s little to fix the subgrade properly and bring a rich reward in permanence of the job. The foundation of the roadway should be too thin or if of concrete, too lean. However perfect the ies made, the conclusions reached as to type of pavement, the ifications, the material contracted for and the intentions of all ies concerned there will not be a good road without proper continuous inspection. Too often an inspector is appointed use he can control so many votes or because he is a jolly good w or because he needs the job rather than because he is com- nt. Hasten the day when an inspector is appointed solely use he knows his business and will attend to it. After your er type of road is properly constructed comes the trying time. top soil or sand clay road, keep it dragged; if macadam, keep little places stopped; if surface treated, patch the little bare es; if bituminous macadam, cut out the little breaks and refill and so on down the line but never lose sight of the three rules good roads, (1) maintain them, (2) maintain them, (3) maintain n. Some of our roadways because of lack of maintenance make think of George Washington Johnson, colored, the leader of a ch choir. His rector went to Boston to get money to build ew Episcopal Church and was much taken with the "High rch" forms he saw there, particularly the use of the burning nse carried in the processional. He determined to try it at e and rigged up a tin can with some brass chain of limited th so that it kept the can rather near the hand of the bearer. choir was duly trained, and G. W. J. chosen the bearer of the drous innovation. At the first public appearance the church packed and the rector led his forces down the center aisle in t glory. When he reached the altar and turned to face the ession his astonishment was unbounded on noting the absence ie incense vessel. He was too game to show his surprise openly, intoned, "What have you done with the incense pot?" G. W. as equally game and answered, "Dropped it on the floor it was lamed hot." Maintenance is "hot stuff" but let us grit our and do it rather than letting our roads go to pieces.

THE CHAIRMAN: We will continue the discussion on this great question by asking Mr. Charles Warner, of Wilmington, Delaware, to give us a few remarks.

MR. WARNER: As a sincere friend and firm believer in concrete for road construction, I present this paper touching on its deficiencies and lines of correction. Most engineers and contractors have overlooked important principles in handling concrete for this purpose. H. Purvis Taylor, Richard K. Meade, Sanford E. Thompson, E. W. Lazell, Ira H. Woolson, Henry S. Spackman, American Society for Testing Materials, Government Bureau of Standards and other prominent engineers and societies have called attention to the following important principles and the best methods of making concrete meet these desirable points:

First: Homogenity and plasticity with a minimum of segregation while mixing and placing.

Second: Elimination of shrinkage during the preliminary hardening period.

Third: Minimizing porosity and permeability to moisture after hardening.

Fourth: Minimizing expansion and contraction due to moisture changes. The intermittent stresses produced in the relatively thin slabs employed in concrete roads by the pressure of heavy wheels and by the exposure to the weather make the full recognition of the above principles of the most vital importance.

This paper will summarize the conclusions of the above prominent engineers and societies on the effect of hydrated lime in concrete mixtures as bearing on these principles. Hydrated lime, now regularly manufactured by over 80 plants in the United States, is a soft, dry, bulky material. Portland cement is comparatively coarse, sandy, heavy and dense. When mixed with sand, stone and water, there is a marked tendency to segregation of the cement. The wetter mixes of concrete used to facilitate its placing aggravate this condition. "Stone pockets" are commonly observed in inspection of concrete work. The reason is evident on watching the flow of concrete upon placing. The direct effect of hydrate additions is to make a fat unctuous concrete, which will flow better and segregate less in transmission.

Spackman said in a recent address before an engineering society: "Durability of concrete is dependent more on uniform distribution of the cement through the mass than on the actual quantity of cement in the concrete."

Edwards, of Edwards and Lazell, engineers, Portland, Oregon, in a recent pamphlet said: "The properties of plasticity and homogeneity which small percentages of hydrated lime give to concrete cannot be secured in any other way at so little added expense for the material used."

For these reasons several of these engineers claim that hydrated

lime is an insurance against poor workmanship and conveying methods which cause segregation.

The question of shrinkage during preliminary setting has been tested extensively by the Spackman laboratories of Philadelphia during the past two years. Spackman has proven that the ordinary concrete used under the usual road conditions shows marked shrinkage the first 24 hours before hardening. Spackman further reports that the best methods of protecting the top of the fresh concrete only partially offset seepage of the gauging water through the subbase. This seepage naturally produces shrinkage and developsincipient fractures which later become cracks and lines of weakness.

In test slabs of concrete with hydrate additions made coincidently, the result during this tender age was decidedly different. In *Concrete Cement Age*, March, 1914, Spackman states that, "with the draining off of the excess gauging water, there is a marked shrinkage in the 24-hour period" and later adds: "The addition of hydrated lime. . . . . markedly reduces the shrinkage due to draining off of the surplus gauging water and also reduces the extent of the movement of the test pieces when alternately wet and dry," etc.

The direct effect of permanent waterproofing of concrete slabs by the use of hydrated lime additions was discussed thoroughly in a series of pamphlets and articles issued by Lazell several years ago. Lazell first analyzes various waterproofing methods and concludes that the introduction of some foreign material or materials into the mixture is the best principle to work upon. He then analyzes the characteristics of such a material, stating that:

> A material to fully meet the requirements should have a mineral base and should be composed chiefly of lime so as to be similar to cement in its chemical composition. It would therefore seem that hydrated lime would be a material that would most nearly fill the requirements. Clay has been suggested as a suitable material but its use in practice would be impractical owing to the tendency of its particles to adhere, forming balls. These balls have little adhesion and hence would injure the strength of the concrete.

Quoting again from a report of Committee D-8 on waterproofing materials of the American Society for Testing Materials:

> In general, more desirable results are obtainable from inert compounds acting mechanically, than from active compounds whose efficiency depends on change of form through chemical action after addition to concrete;
>
> Void-filling substances are more to be relied upon than those whose value depends on repellant action. Assuming average quality in sizing of the aggregates and reasonably good workmanship in the mixing and placing of the concretes, the addition of 10 to 20 per cent of very finely divided void-filling mineral substances may be expected to result in the production of concrete which under ordinary conditions of exposure will be found impermeable, provided the work joints are properly bonded, and cracks do not develop on drying or through change in volume due to atmospheric changes, or by settlement.

On the point of endeavoring to secure this result by richer cement mixtures in the concrete, this same report says:

It has been suggested that impermeable concretes could be assured by using mixtures considerably richer in cement. While such practice would probably result in an immediate impermeable concrete, it is believed by many that the advantage is only temporary, as richer concretes are more subject to check cracking and are less constant in volume under changes of conditions of temperature, moisture, etc. Therefore, the use of more cement in mass concrete would cause increased cracking, unless some means of controlling the expansion and contraction be discovered.

The Bureau of Standards at Washington in its exhaustive report on waterproofing cement mortar states:

This is the most efficient medium and results in an almost impermeable mortar at the two weeks' test. Its value is probably due to its void filling properties and the same results could be expected from any other finely ground inert material, such as sand, clay, etc.

The word "this" refers to hydrated lime used in these tests.

While from the standpoint of producing a waterproof concrete, the various substances mentioned other than hydrated lime might prove equally effective, their use as a substitute for hydrated lime would not give the same plasticity to the mortars or concretes. It would seem dangerous in view of the well known bad effect on the strength of concrete, of silt, fine sand and clay matter in the sand, to add such material to concrete roads, whereas in adding hydrated lime, a material is used that is mildly cementitious in itself, has a different physical action and no risk should be assumed.

Spackman in a recent address before an engineering society in Baltimore stated:

The greater plasticity and readiness to flow into place observed in the use of hydrated lime in concretes is probably a void-preventative and therefore aids in completing the void-filling action noticeable by the use of small proportions of hydrated lime.

Both Taylor and Thompson during the past eight years have exhaustively tested this vital principle of waterproofing concrete so particularly essential in road construction. In their reports made at different times to the American Society for Testing Materials, they show most conclusively the large improvement coming from small additions of hydrated lime in producing practically waterproof results.

One run of tests by Thompson illustrates: A 1–3–5 concrete under water pressure of 60 pounds to the square inch had its flow per hour reduced from 70.6 down to 0.7 grams by the addition of 20 per cent of hydrated lime. In this important series of tests, Thompson brings out the point also observed by Spackman and other engineers that:

The cost of large waterproof concrete structures frequently may be reduced by employing leaner proportions of concrete with hydrated lime mixtures, and small structures, such as tanks, may be made more watertight.

This observation leads to the special problem of leanness in concrete mixtures and its resultant economy. As referred to above in the report of Committee D-8 of the American Society for Testing Materials, and as generally known, the richer a cement mixture, the greater the expansion and contraction under moisture changes. Spackman illustrates this by observing that neat cement moves approximately four times that of a 1–3–5 concrete and that a 1–2 cement mortar will move approximately 50 per cent more than 1–3 cement mortar under the same moisture changes.

A neat cement mixture would move upwards of 4 inches in 100 feet between extreme dry and wet conditions. The effect of movement of this kind in road slabs is evident and the importance of reducing such movement to the absolute minimum for the purpose of permanency goes without saying. Therefore, the use of the leanest concrete mixtures consistent with the desired strength becomes good practice, both for economy and permanency of construction.

This leads to the question of toughness and strength as affected by hydrate additions. The extended tests made by many of these engineers justify the following general conclusions:

First: By substituting 10 per cent of hydrated lime for 10 per cent of cement slightly lesser strengths are noted but the variations are immaterial as compared with variations due to other factors in concrete work.

Second: By the addition of 10 per cent of hydrated lime to the cement ingredient slightly greater strengths are secured. (These substitutions and additions are by weight.

Spackman further made tests on toughness or, more properly, wearing characteristics, by tumbler. The concrete with hydrated lime addition lost 0.6 per cent by weight as against a loss of 1.5 per cent by the corresponding sample of straight concrete under similar conditions. Spackman attributes the improvement to the greater homogeneity and uniformity naturally resulting in the sample using the hydrated addition.

In conclusion, I wish to point out the following:

First: That hydrated lime is now manufactured by many plants under the same strict chemical control as used in the best cement mills and so far as care in its manufacture is concerned, is as safe a material to use as Portland cement.

Second: The American Society for Testing Materials has recognized the position of this material and is standardizing it. Tentative specifications have already been adopted as a guide for the use of engineers to assure a sound and reliable hydrated lime.

Third: Hydrated lime and Portland cement are neutral and there are no unknown or uncertain chemical actions to set up. Therefore, there need be no fear or concern of any uncertain chemical or physical action in the use of hydrated lime in any concrete or cement mortar work.

Fourth: Short stretches of concrete, say 100 feet or thereabouts

will not demonstrate the average improved results in the use of hydrated lime. If it is agreed that the principles set forth in this paper are sound, then relatively large sections of permanent roads under construction, say 500 to 1000 feet, should be subjected to hydrated lime addition and the average result of these hydrated sections should be compared with the result of several miles of straight concrete sections constructed under the same general average conditions.

For these various reasons, I therefore urge as most important the study and practical development of hydrated lime in concrete for all road work. If the conclusions drawn from extensive work and study of the prominent engineers referred to mean anything, they mean that much better concrete results from the judicious use of hydrated lime.

With these deficiencies covered in a practical manner, we have in concrete a road material of great value.

THE CHAIRMAN: The discussion will be continued by Mr. Paul Hannagan, Mayor of the city of Lawrence, Massachusetts and also Commissioner of Engineering.

MR. HANNAGAN: I come from a section of our country where granite is plenty; where the great adamantine ribs of the earth come near the surface and crop out into giant hills and puny mountains.

We are near the highest point of land in the northeastern section of our country, Mount Washington, which towers over 6000 feet above the sea.

The great ice floe of the last continental glacial epoch of ten thousand or a hundred thousand years ago, as you may please to estimate the time, passed over the section where I make my home. It planed down the mountains and filled up the valleys.

So while we have beautifully wooded hills and smiling and fertile valleys the highest point of land is low when compared with the lofty peaks of the Rockies.

The ice floe did a good work not only in levelling things up tremendously but in scraping off the softer rocks which may have formed on top of the earlier formation, leaving vast stretches of the bare granite rock bleaching under our torrid summer's sun or subjected to great contraction stresses in our frigid New England winters.

So we naturally turn to this material, lying at our very doors, for much of our paving material. It is ideal in many ways and we think we are especially fortunate in this respect. Other sections of the country, I know, are as fortunate as we are.

I have read of the old Roman roads. Of that wonderful Appian Way, running out from imperial Rome for an unbroken stretch of 350 miles, begun more than 300 years before the Christian era. How after a lapse of nearly 1000 years it was reported to still be in perfect condition, and that even now parts of it are still in use.

It was built generally 3 feet deep of stones laid in mortar, with a wearing surface of flat stones of irregular shape carefully fitted together. An undertaking which in our day would be prohibitive on account of its expense. It was not more than 18 feet wide in its greatest width, and I think I have seen it estimated that such construction would cost some $250,000 a mile today.

I have read too of the old Roman roads built by that great people in their conquered province of Britain. How they ran north and south, and east and west, giving access to all parts of the province for use in keeping the native people in subjugation.

In Queen Elizabeth's time these roads had been entirely neglected and many of them were impassable. In fact at that time England had no good roads. About London they were said to be fair, but sandy. In the country districts the traveller floundered through mud and tumbled over boulders. The roads were practically impassable to vehicles, in fact, none could be had for hire outside of London. Travel was almost entirely on horseback. There were few bridges and what there were were generally the gift of the church or individuals. For the most part streams had to be forded. The foot traveller, if the stream were narrow, passed over perhaps on a timber which had been felled across, and he was lucky if a hand rail had been provided for his safety.

All down through the eighteenth century there was little improvement, and it was not until MacAdam and Telford began their work that street building became in any way a science.

Every road builder is familiar with their methods, and every city in this country where any stone is to be had has miles and miles of water bound macadam. So common is it that we even spell the name with a little "m."

The natural resources of New England furnish some of the best materials for this method of construction. We have plenty of the hard rocks suitable for macadam, and until the automobile came it was in many ways the best form of construction for country roads and also for city streets of light traffic.

Large areas of Massachusetts furnish field stone in quantities. They were the foot balls, the marbles, of the great continental glacier. They have been rolled about, rubbed down and sandpapered by nature's titantic forces for ages and ages. Much that was soft has been ground into sand and dust. We have great hills of perfect mortar sand, sharp and bright. The larger part of the boulders that are left are hard and furnish a fair road material if the softer ones are carefully culled out.

The old race which first settled our section piled up these stones into walls for dividing the land. They climb over hills too barren even for a sheep pasture, and run down into valleys and swamps where the land seems hardly worth dividing up.

These walls have been a mine of modest wealth in the vicinity of every city, furnishing an easily accessible source for stone for

foundations and later for crushing, particularly for concrete. If considered too soft for a wearing surface for macadam they are at least hard enough for the foundation courses.

Under automobile traffic, macadam, in all the more heavily traveled roads, is proving unsatisfactory. It is so in my section of the country, and I think it is the general opinion everywhere.

Because of the proximity of my city to the great source, the great quarries of granite, I have turned my attention particularly to the development of granite pavements. We are told that the great items to be considered in street pavements are cost, smoothness, noiselessness, durability, sanitary conditions, maintenance, ease of traction, non-slipperiness, ease of cleaning, etc. The granite pavement as I lay it meets most of these conditions perfectly.

Originally many of our cities had cobble pavements. The city of Lawrence was fortunate in having only one street of that material, and that street disappeared so long ago that few remember we ever had one.

Granite blocks laid in the old way with sand joints became in a few years under the wear of the traffic but little better than cobbles. The joints rounded off in a surprisingly rapid way and teams bumped along making a frightful noise and producing most uncomfortable sensations to those riding.

The only way this particular character of wear can be prevented is by filling the joints with a material about as hard as the stone itself. We luckily now have a cement far superior to any which could be procured in any preceding age. So hard is it when properly mixed and used that it is almost as indestructible as the block itself.

While first cost counts to quite an extent in determining the character of a city pavement, I have noticed that it is soon forgotten if the pavement proves acceptable. It is so with all great public improvements. While granite block may perhaps approach the highest in point of first cost, it is really cheaper, in the long run, as no repairs are required. The pavement has become so universally acceptable in my city that no opposition has developed against laying it in large quantities, even to spending 25 per cent of the total city disbursement on this character of work in this present year. Where a few years ago people said they knew when they struck Lawrence by the bad condition of the roads, now they know Lawrence by coming onto streets nearly as smooth as a polished floor.

The durability of granite block can hardly be questioned, at least its durability as compared with other popular pavements. It has one peculiarity. Where most pavements begin to deteriorate immediately on their being subjected to traffic, granite block, for several years, continually improves. This may be a surprising statement, but it is absolutely true. Not only does the pavement become smoother, but less slippery.

All granite blocks are more or less uneven. We expect the irregularities will not exceed one-quarter of an inch, but even this irregu-

larity is noticeable particularly with iron tires on an ordinary wagon, and the speed of an automobile seems to accentuate them.

The cement grout, while it evens up the surface to some extent, is not intended to be left in any appreciable thickness on the pavement, so much of the original irregularity of the granite block remains when the street is first opened. But under the traffic these irregularities gradually disappear, they are ironed out in a way. So monolithic is the pavement that the hammering of heavy vehicles does not affect it in the least.

A large part of the stone we use, preferably the quality we use, is the mica granite rather than the hornblende granite. Instead of wearing glassy with a somewhat gritty surface so that the footing for horses, except under exceptional conditions of ice or slime, improves as time goes by.

In maintenance granite is superior to all pavements. The great drawback in a pavement with us is the cutting of trenches through it for various purposes. Sometimes it seems as though the pavement was hardly down before some individual discovers they must dig it up for some purpose. The objection against digging up the pavement seems to increase their desire to do it.

In a small city where we know so many by their given name, where we are almost like members of one family, it is exceedingly difficult to stop this digging up of a new pavement. In the case of a State or national highway the impersonal condition of the controlling factor makes it easy to forbid much that a government of a small city finds it hard to do. However, I can repair one of my granite pavements so that the patch can hardly be discovered, much less noticed.

Long longitudinal joints in all kinds of pavement, that is joints which from their location in the street can come under the direct line of the travel, must be avoided, for any kind of pavement will wear into ruts if wheels can travel along a joint. So if repairs are made where trenches are cut the pavement must be toothed out, no matter how hard the material or what the character of the joint filler. It makes no difference.

In case of traction I cannot see why smooth granite pavements will not stand as good a test as any other kind. I believe tables of resistance to traction of the various road surfaces place granite some distance below the top. It seems to me that these tests must have been made on worn pavements with sand joints or at least with joints filled with an elastic yielding material. With smoother granite pavements traction resistance will decrease with the age of the pavement, while with other pavements traction resistance continually increases.

In case of cleaning these granite pavements can hardly have a superior. They can be almost as easily swept as a hardwood floor, far more easily than a tar concrete sidewalk.

They can be flushed without the least injury, even with positive

benefit. They respond perfectly to all kinds of mechanical cleaning. In themselves they are practically dustless. Their wear is almost infinitesimal.

In the matter of noise there is less perhaps to be said in their favor. But they are less noisy than granite block having any other kind of filler and their merit is so great in every other particular that the question of noise can perhaps be put to one side for a time until the use of the auto in practically all of the municipal activities which call for transportation eliminates this question entirely, and then smooth granite pavements will be regarded as nearly ideal as anything material can be, until we pass on to the streets of gold in the Eternal City.

I lay my pavement on a sand base. Only exceptional conditions will demand a concrete foundation. The blocks are deep, from 7 to 8 inches. In width they run from 3½ to 4½ inches and in length up to 12 or 13 inches. We estimate they will lay about 24 to the square yard. All our contracts for blocks are by the square yard measured after laying. We excavate by contract by the cubic yard. We haul the blocks by contract by the square yard, and we lay the blocks and finish the pavement with our own help by day labor.

I have never seen a granite pavement fail because of the character of the blocks. Its very life depends on the treatment of the joints. Under my instruction and direction the men employed in doing the grouting on our Lawrence pavements have become adepts in the line. The grout is mixed one to one in special boxes by hand. Because the joint filling is so vital, and makes or breaks the pavement, I have given this particular part of the work my most careful attention and have prepared a set of specifications which in my opinion will meet all requirements.

The Massachusetts State Highway Commission were the pioneers in State road construction. They experiment with every known pavement and keep abreast and ahead of the grand procession of road builders. This season, in Lawrence, they authorized me to build the only piece of road they have in our city, with granite blocks laid in the manner described in this paper.

Within 10 years I believe the Massachusetts State Highway Commission will adopt granite block pavement for most of the State highways, and will lead the world in this method of construction.

THE CHAIRMAN: I see Brother Blair getting up to talk about bricks, but before listening to him we will have a few words from Mr. W. A. Aiken, an engineer from New York City.

MR. AIKEN: The "test of time," that of service endurance, is undoubtedly most valuable to determine the permanent effectiveness of any roadway material for constructive purposes.

Anticipating this, preliminary information can be acquired through

the application of certain accelerated mechanical tests, which from time to time have been standardized by their adoption by recognized authority and promulgated as specification tests. Several years ago the United States Department of Agriculture published a series of test results upon a number of roadway materials, among them slag. Some of the tests used in this investigation, have been formally adopted and issued as standard by the American Society for Testing Materials, upon the recommendation of Committee D-4. It should be noted, that no detailed information, within the writer's knowledge, was given at the time of publishing these test results as to the original chemical composition or method of commercial preparation of the slag reported on, though from the number of samples tested it is to be assumed they probably came from widely different sections of the country. While blast furnace slag in the same district, arising from the use of practically the same raw materials in the process whence it is derived should be comparatively uniform chemically and physically, there will be considerable variation found if comparison be instituted between this product, from different manufacturing districts and there certainly must be greater differences between slags even from the same district, prepared differently for commercial purposes. So that it must be understood that when blast furnace slag is herein referred to, material of limited chemical composition and properly handled in its storage and preparation for market is intended whether its use be for macadam, waterbound or bituminous bound, or concrete construction. The government test results above referred to, have been in a more recent publication noted as having been brought down to 1912. These reveal comparatively more or less fully the physical characteristics of the different materials examined, covering percentage of loss through abrasion, degree of hardness and toughness, tendency to absorb water, compressive or tensile strength, specific gravity and cementing value. Upon an arbitrary scale all results are measured so that within certain maximum and minimum limits, the materials are graded as low or soft, medium or fair, good or hard. It must be realized that a high rating in one characteristic, while theoretically tending to recommend the material, might practically materially impair its average value if radically influencing any other characteristics. One material might be so hard and tough as to show such slight loss in abrasion with consequent low cementing value, that its use in actual service would necessitate the addition of some extraneous binder. This of course would apply more particularly in the consideration of materials for waterbound macadam construction and not be of such moment in bituminous bound or surface treated construction. But it will be recognized that the best material for general roadway purposes, unless special conditions are to be met, is that, wherein is combined in as high a degree as possible as many of the desirable physical characteristics of the ideal material, well balanced. As the theoretically ideal roadway is of monolithic con-

struction, the distinction previously drawn, showing the importance of good cementing value in any material, however otherwise desirable, will be recognized as an important one. It is this property of one of the components of concrete, that gives great value to this material for roadway purposes.

Examination of the test records show that some slag—and mark the author's insistence on quality which can be guaranteed—meets all the test requirements with a particularly high cementing value. This was to have been anticipated since this material closely approximates in chemical composition as it does on a small scale, in mode of production, natural puzzolanic material, whose cementitious value has been utilized for thousands of years. The necessary degree of hardness of any material proposed for structural use must not be sacrificed merely on account of good cementing value, but that blast furnace slag is sufficiently hard to comply with roadway specification requirements, has been developed to the writer's complete satisfaction by a series of tests on concrete specimens, where comparison was instituted between broken stone, trap and limestone and slag used severally as coarse aggregate with identical cement and fine aggregate. These tests, showing average results for each period from 28 days at 3 month intervals up to 1 year, embodied probably the greatest number of individual specimens ever similarly investigated. These were submitted last June to the convention of the American Society for Testing Materials at Atlantic City. The specimens were 6-inch cubes of 1–2–4 concrete and the strength values obtained from the slag concrete at all periods, compared perfectly with the average values in the author's experience of similarly proportioned concrete irrespective of difference in character of the coarse aggregate. The marked porous, sponge like structure of the slag, characteristic of the output from modern furnaces and quite different from the old style glassy, hard, brittle material, aided greatly to produce a monolithic character in the concrete. The specimens upon crushing presented a markedly different appearance to those where the coarse aggregate was broken stone and this is equally noticeable where sections of macadam work are examined for fracture appearance: different materials showing very differently, that from slag on account of its porous structure and high cementing value, showing a much more monolithic type than the general run of materials.

These tests all emphasize the cementitious value of the material as a specially important factor in determining its possible selection over other materials. There are some practical advantages in the use of slag which are not developed by the above laboratory tests—which do appear when the material is put to a practical use in road building. Through sections of the country where natural drainage is poor, this very adverse circumstance tends to accentuate the value of the slag as base material. This must not be interpreted of course, to imply that where practicable, proper drainage is not

to be provided for but only to show that slag shows to advantage where other materials would naturally fail under similar use. Again, with most road materials used in the base, the necessity often exists for bringing in special top dressing. It is the experience of everyone who has used blast furnace slag for roadway construction, that the ordinary side ditch material furnishes, in combination with the slag base, a finish that, in a very short time is surprisingly satisfactory, one which withstands traffic in a manner entirely its own and with use of such side ditch material on ordinary base material, the function of the ditch material simply being to hold the slag in place until the monolithic character of the road is fully developed.

Experience, the "test of time" has generally corroborated preliminary conclusions based on mechanical tests furnishing relative values of different materials. A number of years ago, in the infancy of the awakening thought for better roads, it was authoritatively stated that nearly one-half of this country was very illy provided with materials suitable for roadway construction. Much of the extreme South was undoubtedly referred to in this statement and the appreciation of slag as better material than much locally found, is shown by its widely growing use in the Gulf States. Natural puzzolanic material, wherever available, was used by the Romans, the greatest road builders in the world and the most highly technically educated nations of modern Europe have long recognized the value of that other similar material, slag. In this country, except by management of the large iron and steel industries and by communities adjacent to their plants, little thought, except sporadically, has been given, until comparatively recent, to conservation, through the utilization of the millions of tons of this waste material suitable for roadway construction. Continued and increasing recognition of the material's worth is sure to follow each new successful experience in its application.

MR. BLAIR: Mr. Chairman, I am not going to detain you but a moment and I may surprise you by what I am going to say, in view of what the Honorable Chairman has suggested that I might possibly say. I was particularly refreshed by the statements made by the Mayor of Lawrence, Massachusetts, in all he did say and I believe that the lesson suggested by what he said, was one of the most valuable given to this convention. I am unacquainted with the writer of that paper, I know but little about the pavements of Lawrence, Massachusetts, made of granite, but I do subscribe to what he says based upon his description of the manner and method in which his pavements are built, and therein to me lies the most valuable suggestion in all of the papers that have been read and the greatest lesson to be drawn from them. It is the manner and method of building a pavement rather than the type from which you get the greatest efficiency. We have heard a great deal of suggestions for maintenance; we have said to build the roads and maintain them

and maintain them and maintain them, but here we have a witness coming before us who says the pavements that he builds do not require repairs, and he says it is a hard thing to believe, so that his suggestion comes with a little doubt in his own mind as whether he ought to make the suggestion. Now I want to emphasize and support what he has said by one little statement in reference to a particular experience. In 1901 in the city of Cleveland, Ohio, a medina block pavement was laid, as he describes, around the southwest corner of the square. It has borne as heavy traffic as that city affords upon any of its streets, and every hour and every minute since that time it has grown better without one single cent for maintenance, and it will continue, in my judgment, to grow better for years to come. Now then, out of the same material precisely on another and an adjoining street, with traffic not so heavy, a pavement has been built, which is a miserable dirty, filthy, unsanitary pavement, not fit to live upon or walk upon or use, and it has been so since it was built. I have sometimes heard it said that in compelling a team to draw a load over that pavement the team is compelled to lift the load one-fourth that distance at an angle of 45 degrees. It is the manner and methods in which the pavements are built, and we must not hide behind the fact, we engineers of the country, that the construction is badly supervised, that we have inefficient inspectors. It is upon us to assert ourselves and see that the roads are built exactly in accordance with the specifications and built at their best. I am sometimes heard to say, and I am only going to speak a word with reference to brick pavements, that the brick pavements of this country ought to be built and are built, so that they will grow better for years to come instead of depreciating from the hour that they are built, and it is so and I am glad to be supported by this paper. I am glad that this paper has been read. I myself have built like pavements 30 years ago. The time will come, although it may come slow, when we will understand that we can build hard pavements out of stone and granite and brick that are the most sanitary in the world.

THE CHAIRMAN: There is an old saying and a true one that the common people heard the Lord gladly; He talked to them in their own way and from the point of view that they would understand. We have gone after the country road and the intertown road into the cities where these strong, able pavements are a matter of course. The curse of the cities of our country has been that the choice of the pavement has been left to the selection of abutting owners and not as we have them today, under the supervision of our highway commissioners. An illustration of how people's minds change is best shown in a pavement that was laid in New York City in 1874. One of those pavements was called the Gada pavement, a granite pavement, and it remained there until 1894, and I presume that that pavement had about as much traffic as the Appian Way had

from the day it was laid till the present time, and yet it was covered over afterwards, because it was noiseless, by an asphalt.

We now come down to the people's highway, the roads the farmers built in this country, 2,200,000 miles of road, and they built them themselves without any assistance. Now there's a whole lot of people who want to know what we are going to do with this great question of over 2,200,000 miles of earth roads that are still not under anybody's care and have not been improved. Only 10 per cent of the roads of this country are improved, and I am glad my friend Cooley is to talk to you this afternoon on this great question. I take great pleasure in introducing Mr. Cooley.

MAINTENANCE OF EARTH ROADS

By George W. Cooley

State Highway Engineer of Minnesota

I beg permission of the Program Committee and the delegates present, to change the title of my paper from "Maintenance Methods and Relations to Traffic" to "The Maintenance of Earth Roads." This change is made for various reasons:

First, we all know, either through our own experience or from the experience of other investigators, that the economic value of a highway depends to a great extent on its surfacing, and the care with which that surfacing is kept up. The nature of the material used for surfacing, its value as to hardness, toughness and its recementing quality is generally determined from the conditions of each individual case, but one factor remains forever the same, one rule must be continually in force, and that is a continuous and thorough system of repairs and maintenance. Without the careful carrying out of such a rule, the best of roads will deteriorate, the cost of transportation will become greater with each day's neglect, and our road will become a liability instead of an asset. By far the greater proportion of our roads, especially those in States having a large mileage and a moderate road fund, are the common ordinary earth roads either built entirely from the material at hand or covered when permissible, with a surfacing of gravel, sand, stone or clay, as necessities warrant, or conditions permit.

In the consideration of this subject, it is presumed that the fundamental principles of road construction have been followed, i.e., that an ample drainage system has been provided, and that the subgrade or foundation has been built up without the use of perishable material. Unless our road has been so primarily constructed, weak spots will develop when the drainage is imperfect or where sods or vegetable matter has been used in its construction, and the cost of proper maintenance will become excessive.

In the construction of a new earth road made in an open level or rolling country, the use of an elevating grader is quite common and

under suitable conditions its use is justified by economy in construction work, but its value as a road builder is lessened if the two frequent result is obtained of casting the sods into the road bed, and depending on the regular traffic to thoroughly consolidate the mass so built up. This can be avoided by the use of a tractor in hauling the grader, which thoroughly pulverizes and packs the material cast in by the grader.

We may safely take it for granted then that in any road bed carelessly constructed with a large percentage of vegetable matter, the future bills for repairs and maintenance will be governed largely by the quantity of unsuitable construction material used, and in case of a lax system of construction, a more elaborate system of maintenance must be adopted.

I quote the following from Mr. L. W. Page, director of the office of public roads:

> Overtopping all other road problems in its importance is that of maintenance. The destructive agencies of traffic and the elements are unceasing in their activities, and it is idle to talk of permanent roads any more than to speak of a house, a fence or railroad ties as permanent. The public roads today, by reason of the exceptionally obstructive traffic conditions, are more costly in construction and this cost is continually increasing with the advance in the prices of labor and material. It is criminally wasteful, therefor; to invest large sums of public money in building the highways demanded by traffic, unless the investment is conserved by adequate maintenance.

We conclude, therefore, that continuous maintenance being such an important factor in the general scheme, especial effort must be made to install a satisfactory and economical system as soon as a road is opened to travel. In some of our western States, the plan has been suggested of requiring contractors on surfaced roads to provide for maintenance as soon as any section is completed, and continue the same for at least thirty days after the work is accepted, thus giving time for the engineering department to provide for the organization of a maintenance crew without overlapping or interfering with the work of construction: and in Minnesota the plan has been adopted in the construction of earth roads to require the continual use of a drag or planer on grade building. This latter plan has been found very efficient and renders future work on the surface less expensive, besides tending to produce a more compact road bed. The tool found most satisfactory in this work is that known as the "Minnesota Road Planer" which consists of the two blades of an ordinary road drag, fixed between a pair of runners about 14 feet long, the blades set at an angle of about sixty degrees to the runner and made rigid or adjustable as may be deemed best. The planer is hauled on a line parallel with the axis of the road and its operation is similar to that of the ordinary drag, with the additional advantage of making a smoother surface. The old style drag without runners has a tendency, especially on new work, to increase the "waves" or undulations frequently occurring on road construction, while the planer eliminates these faults, and as a general maintenance tool has proven the most satisfactory.

An important feature of maintenance is prevention of the growth of sod and weeds along the travelled track. When sod is allowed to form along the highway, it has a tendency to catch the dust and wash from the road surface, and soon becomes a high tough shoulder, preventing drainage. The use of a spring tooth harrow along the roadside two or three times a year will prevent this growth.

The State of Minnesota has given special attention to the matter of maintenance and in the present road laws have made adequate provision for the care of all roads. Township and county roads constitute approximately 90 per cent of the road mileage of the State, and of these roads, about 90 per cent are earth roads. To care for the town and county roads, a one mill tax is levied on all property in the town the proceeds of which constitutes the town dragging fund. This fund is expended under the direction of an overseer, appointed by the town board, for the purchase of drags, and in dragging all roads of the town, excepting State roads. This appears to be the most satisfactory method of caring for the earth roads under control of the local authorities, but there should be a provision in such cases, for general supervision of the work by the county highway engineer.

For the care of State roads in Minnesota, 20 per cent of the State road funds, with a due proportion of county funds, are set aside and may not be used for any other purpose than maintenance of State roads. As the State roads include all types of construction, different systems of maintenance have been required in the different localities. In general, three systems have been established: The patrol system on macadam and well built gravel roads, and the maintenance section system, and road drag system on other roads, all being under the direct supervision of the district highway engineer.

Under the patrol system, one man is assigned a section of from 5 to 7 miles of road and works with hand tools. It has been found necessary to supplement this work with the occasional use of a team and in that manner it has proven satisfactory on macadam and gravel roads.

Under the maintenance section system, one man is given charge of a section of from 20 to 30 miles of road and is employed continuously with his team on the care of his section. He is given authority to employ additional help, both teams and men, and usually has two teams and four or five men at work. Contracts are also entered into by the section foreman with residents along the road, for the dragging of same after each rain, or when ordered to do so by him. The section crew takes care of all minor items of construction, such as placing culverts, etc., and we have found that the work when properly done, is really of a constructive nature. This system is without doubt the most effective, and is being adopted generally throughout the State.

The dragging system requires the employment of a superintendent of maintenance, who for convenience should be one of the engineer's assistants, whose duty is to contract or make arrangements for the

dragging of all roads under his charge, and to see that the work is done at proper times. This system is suitable for slightly undulating prairie country, where most of the roads are of earth, and to get best results, the superintendent should have at his disposal light graders to reshape the road bed at least at the beginning of each season.

On earth or gravel roads, no maintenance system is complete which does not contemplate the use of planers or similar devices, and a combination of work as outlined under the section system is recommended.

I have been asked to state something about our plan of raising funds. We have a law by which we levy a tax of one mill on the total assessible property of the State. That gives us $1,500,000 every year, which we distribute in such a way that no county shall receive less than 1 or more than 3 per cent. That money is allotted to the counties in the office of the State engineer under a plan whereby the county having a valuation of $5,000,000 pays 20 per cent and the State 80 per cent; a county having between $5,000,000 and $10,000,000 pays 30 per cent and the State 70 per cent; a county having a valuation between $10,000,000 and $15,000,000 pays 40 per cent and the State 60 per cent, and in all other counties, the State pays half and the county pays half. We have a district engineer in every county in the State who has a supervisory control of all work done in the county. Before payment is made on any work, it must be approved by the district engineer.

THE CHAIRMAN: Mr. Diehl of the Committee on Resolutions desires to make an announcement.

MR. DIEHL: I would like to say, gentlemen, that the Committee on Resolutions met this morning and afternoon and will hold another meeting this evening. They desire to present their report at tomorrow's session and therefore request all delegates who so desire to present their resolutions in order that they may be considered at the Committee meeting this evening.

THE CHAIRMAN: The discussion of the "Earth Roads" will be continued by Mr. H. R. Carter, who is the State Highway Engineer of Arkansas. That State has made a recent appropriation of $1,250,000 which has been placed in his charge. The State has some 36,000 miles of roads and they have improved about 1000 miles as I understand it, sand-clay roads. We will be very glad to hear from Mr. Carter in regard to this great question.

Mr. Chairman and Gentlemen: Unfortunately, I did not arrive as early as I should have and as a result I have been unable to secure ...y of Mr. Cooley's paper, however, if I had secured it I am sure ...d not have found many more points to discuss because he has ...d his subject thoroughly.

In Arkansas our problem is now and will be for some time in the future, a problem of the construction and maintenance of earth roads. I might say though, as the chairman has told you, that we now have approximately 1000 miles of improved roads, I mean by improved roads, gravel, water bound macadam, tarvia, bituminous macadam, and concrete roads. I merely mention these facts in order that you may become more conversant with conditions that exist in our State. We built the best possible roads with the money available.

The speaker does not desire in any way to criticise Mr. Cooley's paper, but there is one point, although a small one, that I would like to discuss for a short time, that is, the use of the road drag. Mr. Cooley mentions in his paper that in Minnesota a road planer is used which replaces the old road drag, his reasons being that the planer eliminates waves. In other words, the Minnesota planer is used for a cutting tool as well as for a drag. I do not think excessive waves will form if the road is properly constructed, I mean by this that if weeds or other perishable matter is eliminated, drainage properly cared for and the road thoroughly dragged as often as is necessary.

Mr. King the father of the split log drag has said that his drag is based on the principle that the top surface puddles in successive layers and that the action of the sun as result of this puddling produces a baked surface or a sort of a sun-brick, which sheds the surface water. The strength of this crust increases in proportion to the use of the drag. If these are facts the use of a planer or a cutting tool, it occurs to me, would destroy just the results we desire, i.e., the sun-baked surface. I wish to here state that we have never used the Minnesota planer in Arkansas and it is for this reason I have raised this point hoping that it will be discussed by others present.

In conclusion, I desire to congratulate Mr. Cooley on his paper and hope we will meet again.

MR. COOLEY: Referring to the use of the split log drag, I am willing to concede that the split log drag will do almost everything, but I know this, that nearly all of our country roads are soft, constructed of soft material. Now you cannot throw up a country road of the material we have in the western country and find it uniformly homogeneous all the way through, there's bound to be some places softer than others, and those are the places that make chuck holes to a certain extent. Of course if a road is properly constructed, it might not do so, but under ordinary conditions there will be chuck holes every once in a while. If you put an ordinary split log drag on that road you will find that the ends of the drag will dip down in some of those holes and won't be as effective as if the drag is encased in a frame about 14 feet long, because it will shave off the highest point and deposit the material in the lowest. I have been using those drags for 14 years and the best ones I found

were made of 2 x 4. I find that the planer was quite satisfactory in every respect and I would be glad to demonstrate it by the picture of the machine which will convince anybody of its merit. It is really a very satisfactory machine. There is no patent on it.

MR. BLAIR: Please tell us how you drain the roads in Minnesota?

MR. COOLEY: It is all surface drainage except that in some of our roads we have put in catch basins on the side, the same as here, and the water is carried across the road instead of over, but nearly all our drainage is surface drainage. We make our roads about 30 feet wide, 30 feet from the foot of one slope to the foot of the opposite slope, with a wearing surface of about 14, 18 or 20 feet and two ditches about 5 feet wide.

MR. BURGESS (of Illinois): In defence of Mr. Cooley's paper, I have got one to stick into the road drag. Up in our country—I live in central Illinois, and I might as well say that I am a farmer, a stock man; as I said at one of our State meetings, I live in the country 4 miles when the roads are good and 20 miles when they are bad. I started into the road business because our commissioner had turned down a mile of macadam road at no expense to the community and the people thrust the job on me. We spend $5000 for road work in our township, 6 by 8 miles square, every year, and the roads were no better than they were 20 years before. I bought a gas tractor, used some horse graders we had on hand and wore out an old leveler made right in the neighborhood, and finally bought a heavier machine. I put up my grades so we had a good crown, good gutters on each side that carried the water to lateral ditches. Our county is underlaid with big dredge ditches and smaller laterals to them, so the only drainage we need is surface drainage. I made an average crown of 2 feet to the gutter, so that water, when it falls runs off into the gutters and is carried to the ditches. We leave the ditches open. There is a good deal of tile, but because of our black mud the ditches become puddled and the water must be carried off by surface drainage. With tile you have to dig catch basins to let the water down, but it is not necessary with us when we get our roads up, the water runs down to the gutters. In our part of the country the drag is a complete failure. Mr. Johnson our State Engineer for several years—came there and put up some improved roads, in fact he put me on to how to build these roads. After we got them up he said, "Now I want you to drag them; drag them," and fixed me up three different kinds of drags. The drag was a failure, because we never could get them wet enough and they would roll up under the drag. We could go out and drag in a rain but it would still roll up. There are two periods we can drag, when they are frozen and will thaw down an inch or so and just before freezing it will do all right. Instead of using that sort

of drag, we have a machine that we call a Monroe leveler. I have no connection with the Monroe people; Monroe is a farmer and this machine is built with I-beams and carried on four wheels. The I-beams are about 30 feet long and are fitted with cutting edges. After you put the grade up once, they will go clear to the gutters and bring in the dirt gradually. Then we use what we call a pulverizer behind that. That spreads the dirt instead of leaving it in a potato ridge, as we call it. Everybody has this machine and we use a heavy block behind this that spreads it out, grinds up all the little clods and leaves the top pleasant to travel on. I have found that the important thing in building a road is to fix the top, the center, so that the traffic will stay on it when it is muddy. Our grades are brought up with a good slope so that you cannot travel the sides when it is muddy. Mr. Johnson said, "After you have a good heavy rain, 'phone me and I will come up and show you how to do this;" when I 'phoned he came up and said, "I have heard there was soil you couldn't drag and you have it." This Monroe leveler is the only thing we can use; with it we can cut off the little knobs and level it down and work it just as quick as we can get an engine over it. We work the roads every day they are fit to work, and if you come through our township, no matter which way you go though it, you know it is Bement Township by the roads. We have the best roads in the state; we maintain them every day, and if you don't do that, you can't have a good dirt road.

THE CHAIRMAN: I am glad the last speaker brought that up. I always felt that we never devoted enough time to the question of earth roads. The commissioners that come from the East and New England where this great movement started, with them it is a question of refinement in road building—here this great country is lying in the mud. We ought to have more time for drainage and more time for earth roads. I am very glad to know that we have with us today one of the pioneers in road building. We have all gone to Massachusetts, the dear old State, when we want to learn something. They always receive us pleasantly and give us all the information at their disposal. I know of no State in the Union that has assisted more in the development of road improvement than Massachusetts. We have with us today Colonel William D. Sohier, Chairman of the Massachusetts Highway Commission, who will tell us how to take care of these great highways and what they have done with surfacing.

ROAD MAINTENANCE

THE MAINTENANCE OF SURFACED ROADS OUTSIDE OF CITY PAVED STREETS AND NOT INCLUDING CITY PAVEMENTS

By Col. Wm. D. Sohier

Chairman Massachusetts Highway Commission

The absolutely essential prerequisite to a good road is proper drainage. If the road has not proper ditches and proper drains to carry the water away from the road at all times, it will soon become either a bog or a ditch. The second absolutely necessary condition is drainage. If the road has not the proper foundation properly drained to carry off the water into the ditch or drain the water away from the road, the road will soon become worn out, rutted, and a bog-hole. The third absolute necessity is drainage. If the road does not have a surface properly constructed and at all times proper maintenance so that it will carry the water off of the road surface at all times, holes will soon develop and then ruts, and the road will be rapidly disintegrated and worn out.

And that brings me to the absolute necessity of constant maintenance at all times in order that the road surface may at all times carry off the water and contain no holes or ruts which can hold water.

If the road is to be properly maintained, it must in the first instance be properly constructed.

The materials and methods used must be adequate to withstand the traffic that goes over the road without serious deterioration in a few months or even a year or two. This means that the road surface as much as the bridge and the road foundation as much as the bridge foundation must be able to stand without being destroyed the heaviest moving load that is going over it.

I am giving a number of tables showing the cost of maintenance in France and England and Massachusetts, with some tables on traffic that will illustrate this point. We can well learn something from the experience of other countries where road building has been a science for nearly 70 years in France and for the last 25 or 30 years in England.

MAINTENANCE OF FRENCH ROADS

They established their French road system beginning in 1826, and constructed their total road system of 371,000 miles in about the next 25 years.

Their roads, practically uniform except as to width, have been built almost entirely of local macadam originally, 6 or 8 inches deep on a proper foundation. In resurfacing some of the main roads in later years they have used a harder stone and Welsh or Belgium granite. The macadam surface of the road on the Routes Nationales is 24 feet; Routes Departmentales, 18 feet, and the roads

de grande communication and d'interest commun, 15 feet. The yearly cost of maintenance has been $273 a mile on the Routes Nationales, this maintenance cost varying to $78 a mile on the 184,000 miles of ordinary country road of only local interest.

The French engineers last spring estimated that some 8000 miles of road ought to be resurfaced, using a tar macadam, because of the large increase in automobile travel around the cities, which travel was rapidly destroying their macadam roads, and they requested the government to furnish $60,000,000 for that purpose, about $7500 a mile.

Their greatest problem for over 50 years has been maintenance. The roads are maintained practically by a central organization. The whole country is divided into 86 departments, and all of the county and rural roads within the department are managed by the prefect of that department, and the expenditures appropriated by the council.

Direct charge is in the hands of a centralized body of competent engineers, about half of whom are graduates of the National School.

Each department is divided into four or five political districts, each district being called an arrondissement, and the roads are in charge of a district engineer, who is under the direction of the chief engineer.

Each arrondissement is again divided into districts or cantons, and an assistant road engineer under the direction of the district road engineer looks after all the county and rural roads within the canton.

Then comes the final subdivision, where the roads are divided into sections of a few miles long, taken care of by patrolmen. All of these are under civil service and the men are promoted from time to time according to their ability.

The table shown below gives the approximate cost of maintenance on the French roads, annually:

	Miles		*Total Expense*	*Per Mile*
Routes Nationales	23,800		$6,500,000	$273
Routes Departmentales	8,100	115,400	1,500,000	185
Chemins Vicinaux De grande communication	107,300		16,900,000	157
d'interest commun	47,500		6,000,000	126
ordinaires	184,700		14,500,000	78

Five or six patrolmen are under a foreman who is also a patrolman. When any resurfacing or reconstruction is to be done they use machinery, rollers, etc., belonging to the department and collect together enough of the patrolmen, with a section foreman, to reconstruct the road under the supervision of the district engineer. This provides them with men who are thoroughly familiar with the work.

You will note that the French engineers state that on the main roads near the cities the $273 a mile a year for maintenance is not

keeping the roads up; that they need $60,000,000 to resurface with tar macadam 3000 miles of these roads at a cost of about $7500 a mile; that is, practically one-third of their main roads should be of tar macadam. If this expenditure is made in say a five-year period, or $12,000,000 a year, it will increase the cost of maintenance on their 23,800 miles of national roads about $500 a mile a year for resurfacing on the average, and will make their total maintenance charge on their main roads $770 a mile in place of the present cost of $273 a mile. Of course, if spread over a ten-year period it would only increase the cost half as much, the present roads would be practically impassable. This is in accordance with our Massachusetts experience on our State highways where our expenses per mile including resurfacing averaged over $850 in 1913.

MAINTENANCE OF ENGLISH ROADS

Originally there was no road system in England. Everyone made his own road. Then came "statue labor" which was required by a general act passed in 1555. This practice was not superseded by Highway Rates until 1835. The roads were cared for by the parishes, and a little later several parishes were combined in a highway district.

In 1663 England began to pass "Turnpike Acts," authorizing the creation of a corporation with trustees, who were to build roads, maintain toll gates and charge tolls.

By 1833 Parliament had passed 3800 Turnpike Acts, and created in England and Wales 1116 Turnpike trusts, controlling 22,000 miles of road. They almost all failed and in the 22 years after 1864 the number of Turnpike trusts was reduced from 1048 controlling 20,589 miles of road to 20 trusts with 700 miles of road.

In 1878 the cost of these main roads which had been disturnpiked was placed upon the counties. In order to even up the expense more or less the English government made appropriations to aid in the maintenance of these main roads, beginning in 1882 with an appropriation of about $800,000. In 1888 about $2,500,000 was appropriated, and now the Road Board has something over $6,000,000 annually which can be spent in improving the main roads.

They have now a combination of the county taking care of the urban and rural main roads, with the parish and local authorities taking care of the rural roads. The main roads are something over 20 per cent of all the mileage, leaving out London.

In almost all of the counties they have sections of road in charge of regular maintenance men. They have almost universally been obliged to give up the old system of patching the roads by putting in loose broken stone from the roadside because of the large number of automobiles that threw it out so rapidly, and they have substituted patches made of either tarred stone or tarred slag, or the patches are made by a painting method using stone chips and dust.

Most of the main roads in England outside of Metropolitan London

and the other large cities, are maintained by the use of tar. Some 40,000 miles of road were tarred in England last year, and some 6500 miles were built of tarred macadam. Their system of maintenance now is not only to keep the roads constantly patched, but every year or twice a year on their macadam roads they usually flush them and roll them filling the holes and depressions first and adding a small quantity of chips and stone dust. On the tarred roads a section man keeps them constantly patched. They usually require a fifth or a sixth of a gallon of tar per square yard which is sprayed on once a year, and this is covered with pea stone or gravel and kept covered so it won't pick up. The tar is usually sprayed on under pressure.

Where they have heavy traffic they are resurfacing their roads with tarred Welsh granite which is like our Trap Rock or with tarmac which is a tarred iron slag. They also build a road of three-inch stone, rolled hard, and grout it with a mixture of hot sand and hot tar, equal volume, poured into the road until it flushes it, and roll in 1½-inch stone and smaller stone with a surface coat of tar and sand. They find their macadam roads with a tarred surface require re-treatment every year. This costs about 2½ to 3 cents a square yard a year. On the tar-mix roads they require a new coat of a fifth of a gallon of tar applied on the surface every two years.

I am giving you in a table the cost of maintenance on the various classes of road in England, in which you will see that the average cost is $1100 a mile a year to maintain the county urban main roads, and the county rural roads $431 a mile a year, while the rural roads which are merely of local interest cost about $122 a mile a year to maintain.

	MILES	MAINTENANCE	AUTHORITIES, COUNTY ENGINEERS	YEARLY MAINTENANCE PER MILE
County Councils:				
Urban Main Roads	4,189	$4,601,790	61	$1100
Rural Main Roads	23,565	10,177,740		431
	27,754	14,779,530		
County Boroughs	9,366	6,437,380	28	685
London Authorities	2,192	3,691,355	2	1680
	11,558	10,128,735	30 Road Authorities	
Urban Roads	11,411	4,848,020	1733	425
Urban Roads	4,871	2,701,710		555
Rural Roads	95,077	11,562,920		122
	111,359	19,112,650		
Totals	150,671	$44,020,915	1898	290

The total expenditures per year, including improvements and interest, $75,990,000.

CONSTANT MAINTENANCE

In both France and England they keep the roads constantly patched. But in France near the large cities where there is a large amount of automobile travel, they have been unable to keep their water-bound macadam roads in good condition. Many of them are rough with a large number of pot-holes. Around Paris they have replaced the water-bound macadam with a tar macadam top 3 inches in depth on many of the roads that were undoubtedly worn out and rough and impassable five years ago.

In both countries on the main roads they keep section men constantly patching the roads. They add a little additional stone, flush them out and roll them every year. On the main roads where there is much automobile travel they are using tar in making their patches, as they found that the old method of putting on loose broken stone and letting the traffic roll it down is of no use because the automobiles throw the stones out over the road.

They are patching by two methods, more commonly using a tarred stone or tarred slag with tarred chips, cutting a square edge if there is a pot-hole and tamping the tarred material in. The largest stone used are at least three-quarters of the depth of the hole. In other places they are merely painting the little place where the tar fails and covering with pea stone or pea gravel.

In resurfacing in both countries they are using a large stone about the 3-inch size. In France where there is not a great deal of tarred macadam they are using a hard Belgium granite on the main roads, doing one-half the width at once.

In England they are using the same large size stone coated with tar or a tarmac (tar-coated iron slag). Most of their engineers use very little small stone with it. They use practically all large size with tarmac as it compacts under the roller. Some of the county engineers use 10 per cent of the fine material. They also do one-half the road at once. The engineers state that they have been forced to use this larger stone in resurfacing because of the motor trucks and the large number of traction engines with trailers. Our practice in Massachusetts is the same, except that we are very often on heavy traffic roads using asphalt or some asphaltic bitumen rather than tar because our experience leads us to believe that it is worth the additional cost for the material.

We are also in Massachusetts—somewhat experimentally as yet as we have only done three or four miles—resurfacing with the tar and sand mixture grouted into the three-inch stone described above.

In England, France, and Massachusetts we have found it necessary and economical with the change and increase in traffic to very much diminish the crown of our macadam roads.

Formerly with macadam surfaces 15 feet in width we used a crown of three-quarters of an inch to the foot. We now try to secure about a quarter of an inch to the foot on our bituminous macadam roads, and in resurfacing the old roads we are widening the macadam sur-

face to 18 feet in place of 15, as our experience shows that traffic otherwise will spread over the edge of the road and rapidly sheer down into the macadam and narrow the road up.

In England they have been forced to do the same; to wit, widen the road and diminish the crown, because they found that the traction engine with trailers, of which they use large numbers, would shear down into the macadam, thus rapidly destroying their older roads. They now universally use a crown that does not exceed one inch to the yard.

The result of this in England and Massachusetts has been that the traffic has spread all over the road, that no rut has developed and no horse track, a tremendous change from a few years ago when the center of the road as a horse track wore down quicker than the sides.

In traveling over 2,000 miles of road in England this year and last, I didn't see a single rut and practically not a single pot-hole.

MAINTENANCE OF STATE HIGHWAYS IN MASSACHUSETTS

Our Commission began building roads in 1894. The earlier roads were almost entirely macadam with a few miles of gravel or graded road. The standard road with necessary foundation and proper drainage wherever necessary was 15 feet in width, water-bound macadam either of trap or local stone, 6 inches deep in the center and 4 inches on the sides, with a 3-foot gravel shoulder on each side and with a three-quarter-inch crown to the foot.

The ordinary cost of maintenance I am giving in a table, but up to 1907 when some of the roads were 12 years old, the cost of ordinary maintenance was substantially $100 a mile a year. Ordinary maintenance with us consisted merely of keeping the gutters, catch basins, and drainage, open and clean, cutting out the grass and brush on the roadsides, keeping the shoulders in proper condition, spreading a little gravel or sand on the road surface from time to time and filling the few holes or ruts that might occur, with broken stone or gravel. Very few miles of road had been actually resurfaced prior to 1907.

In 1906 the automobiles began to come. Our roads were some of them 13 years old and only half the original depth of stone was left. We soon found that automobile travel, especially at high speed, disintegrated or tore up the macadam or gravel roads, especially on the curves, as soon as there were any considerable number, say 50 or more in a day. The traffic, of course, increased tremendously in the number of vehicles, because of the large mileage of the automobiles. What had been country roads developed, between that year and the present year, into main through routes carrying oftentimes away out in the country on a main route over 1000 cars a day.

TRAFFIC AND COST OF MAINTENANCE

In connection with maintenance, of vital consideration is traffic. I, therefore, am submitting a table showing the average traffic on the Massachusetts State Highways in 1909 and 1912.

Increases and Changes in Traffic from 1909 to 1912

In Massachusetts the traffic using our roads is constantly increasing, but it is changing much more rapidly than it is increasing. This is conclusively shown by the following table.

KIND OF VEHICLE	1909 CENSUS, 238.5 STATIONS			1912 CENSUS, 156.5 STATIONS			
	Av. total No. per day	Av. No. per day per Sta.	% of No. per Sta.	Av. total No. per day	Av. No. per day per Sta.	% of No. per Sta.	Increase or decrease, %
Motors:							
Runabouts	4,958.5	20.8	8.5	5,819.0	37.2	11	+79
Touring cars	17,950.5	75.3	30.5	27,178.5	173.5	49	+130
Trucks				1,800.0	11.5	3	
Total motors	22,909.0	96.1	39.0	34,797.5	222.2	63	+131
Horse-drawn vehicles:							
1-horse, light	17,033.0	71.5	29.0	8,380.0	53.5	15	−25
1-horse, heavy	11,762.5	49.3	20.0	7,458.0	47.6	14	−3
2 or more horses, light	1,006.0	4.2	2.0	556.0	3.6	1	−14
2 or more horses, heavy	6,205.5	26.0	10.0	3,870.5	24.7	7	−5
Total horse-drawn	36,007.0	151.0	61.0	20,264.5	129 4	37	−14
Totals of all kinds		247.1			351.6		+42

Also, a table showing the traffic on certain roads at night.

We had a count made for 24 hours a day at a few points, and the result may be interesting, so I print a short table.

Day and Night, 12 hours each—October, 1912

	AUTOMOBILES		VEHICLES (ALL KINDS)		TOTAL VEHICLES	PERCTGE. AT NIGHT
	Day	Night	Day	Night		
Lexington	302	59	438	104	542	19
Watertown	373	72	671	141	812	17
Chelsea	103	10	358	53	411	13
Somerville	266	70	689	231	920	25
Boston	358	60	513	94	607	15

I computed several night and day counts for the two years to get and average, and found that on the average the night traffic constituted about 18 per cent of the total traffic; consequently, one should add about 22 per cent to the 14-hour day count to ascertain the total number of vehicles.

And the traffic in some of the parks around Boston.

Pleasure Traffic Around Boston

The census near Boston in the parks may be interesting, but it must be remembered that it is, in many instances, light pleasure traffic. The following figures relate to the census taken in August, 1912.

Metropolitan Parks
(Mostly Pleasure Vehicles)

LOCATION	TOTAL OF ALL VEHICLES	MOTOR VEHICLES	% MOTOR TO TOTAL TRAFFIC
Lynn, Prescott Pl. & Shore Res.	1,530	1,411	92
Revere, Saugus River Bridge	1,872	1,808	97
Somerville, Alewife Bridge	491	474	97
Medford, Parkway and Main street	515	492	95
*Somerville, Wellington Bridge	2,526	2,174	86
*Milton, Mattapan Bridge	2,383	1,717	72
Medford, Malden River Bridge	1,834	1,848	98

Boston Parks
(All Classes of Vehicles)

Prince St., Jamaica Plain	1,934	1,715	89
Commonwealth Ave., a city residential street	3,009	2,634	88
Washington St., a suburban city avenue	1,109	671	60

* All classes of vehicles.

At the last two points there were daily 247 and 296 heavy teams.

I am also giving a table showing the cost of construction, repair, and maintenance of State highways in Massachusetts for 19 years.

Cost for Construction, Repair and Maintenance of State Highways, from 1894 to 1913

REPAIR AND MAINTENANCE			STATE HIGHWAYS		
Year	Cost	Miles	Av. cost per mile per year	Miles laid out	Cost of Construction
1894				39.88	
1895				50.03	$637,847
1896	$4,727	89.10	$53.05	37.02	458,581
1897	13,267	126.01	105.28	53.25	482,076
1898	20,661	179.26	115.26	42.68	499,783
1899	24,538	221.94	110.56	44.56	407,309
1900	33,562	266.50	125.93	49.40	396,459
1901	31,061	315.90	98.32	61.68	453,826
1902	59,943	377.58	158.75	53.32	466,743
1903	55,083	430.90	127.83	74.17	443,972
1904	51,896	505.03	102.76	60.85	445,745
1905	57,456	565.88	101.53	56.55	509,007
1906	68,382	622.45	109.86	47.92	444,655
1907	106,189	670.37	158.40	39.33	467,944
1908	147,037 82,628*	709.70	323.47	38.40	564,719
1909	247,986 154,131*	748.27	537.39	36.53	431,814
1910	214,561 289,498*	784.80	642.28	52.80	462,165
1911	213,476 316,603*	837.59	632.86	42.00	412,542
1912	208,587 414,407*	879.59	708.39	40.72	366,424
1913	203,762 595,183*	920.31	868.13	60.06	909,063
				980.88	9,262,674

Average cost of Repair and Maintenance, 1895 to 1907, inclusive, $105 per mile per year.

Average cost of Repair and Maintenance, 1908 to 1913, inclusive, $619 per mile per year.

Average cost of Repair and Maintenance, 1895 to 1913, inclusive, $267 per mile per year.

* Motor Vehicle Fees Fund.

In this connection I am giving a table showing the number of motor cars registered in Massachusetts from 1906 to 1914 inclusive. You will note that the number of automobiles registered has increased from about 7300 in 1906 to over 84,000 in 1914, and fully one-third of the traffic on our main roads consists of automobiles from other States.

You will note also that there were less than 1000 trucks registered in 1909 and five years later in 1914 there were 8000—8 times as many.

Statement Showing the Number of Motor Cars Registered and Licenses Issued, 1906 to 1914

	1906	1907	1908	1909	1910	1911	1912	1913	1914
Autos (pleasure)	6,572	7,733	18,066	23,011	29,792	36,284	46,096	56,712	68,100
Dealers' autos	755	455	1,905	2,455	3,305	4,920	6,301	7,462	7,898
Trucks				960	1,568	2,623	4,036	5,948	8,053
	7,327	8,188	19,971	26,426	34,665	43,827	56,433	70,122	84,051
Operator and chauf.	10,083	10 696	13,170	18,251	41,259	51,950	66,645	81,034	95,577
Total Receipts	$33,085	$92,096	$121,488	$169,973	$374,789	$477,417	$616,245	$764,153	$914,119

Prior to 1907, certificates of registration did not expire annually.

Prior to 1909, trucks were not classified.

Between 1903 and 1907, all automobile registration fees were $2.

In 1907 the automobile registration fee was increased from $2 to $5. In that year 9006 cars, registered at $2, were re-registered in the same year at $5.

Beginning January 1, 1910, the automobile registration fees were based on the horse-powers of the vehicles, the fees varying from $5 to $25. The fee for registration of a truck, however, was $5 regardless of the horse-power.

Prior to 1910, operators' licenses did not expire annually, but continued in force indefinitely. Since 1910 all licenses have expired annually.

Increase in Maintenance Cost

Starting in 1907 you will note that our cost for maintenance has risen by leaps and bounds from $158 a mile a year in 1907 to over $850 a mile a year in 1913, and it is still higher in 1914.

Our roads were rapidly going to pieces. We needed some money. We got the Legislature to double its appropriation of $100,000 a year and make it $250,000 for one year and $200,000 a year since. We secured an increase in the automobile fees, and had four-fifths of that money available for the maintenance of State highways, and the other one-fifth for the improvement or maintenance of through routes in the towns.

We found that our old roads were being destroyed by the rapidly

increasing amount of automobile travel. The traffic on the roads had increased from 10 to 40 times in volume.

Our roads, both gravel and macadam, were rapidly being torn up by the automobiles and deposited in dust over the country. They were rutted, pot-holes developed, and, as you see, we had to increase our maintenance cost. The question was, how to best preserve our old roads.

In 1907 we began to use a bituminous material as a surface coat. We used refined tar and a heavy cold asphaltic oil, applying about one-half gallon to the square yard.

Proper Methods for Economical Maintenance

In passing let me say as a result of our experience in the use of bituminous binders on road surfaces, that we invariably true up the surface and patch the holes and ruts first. We invariably thoroughly brush and clean the road down to the stone or hard gravel. We invariably spread our bitumen, whether tar or asphaltic oil, evenly and under pressure. We invariably cover it and keep it covered so that it will not pick up, brushing the cover back from time to time when necessary. We cover it with pea-stone and dust, unless we can secure a good pea-stone in sand or gravel, or we coat it when the other method is too expensive and traffic is light, with a coarse sharp sand. Thereafter, constantly and eternally, we keep the road and road surface patched, using in patching substantially the same bituminous material that was used for the surface coat.

We used one-half gallon per square yard of heavy asphaltic oil that had to be heated to 250° spread upon the road. We used the same quantity of the heaviest oil that could be spread cold. Where we had only money enough for a dust layer, we used one-fifth to one-quarter of a gallon of light asphaltic oil per square yard, this oil sometimes being called a 40 per cent oil. We used one-half gallon of hot refined tar, and we have used after the first application one-quarter of a gallon of the same tar yearly. We have used water-gas tar and various proprietary materials of a bituminous nature known by various trade names. In every instance that has succeeded the road has always been properly cleaned and patched beforehand, and has always been covered and kept sufficiently covered to prevent its picking up. It has been constantly patched.

Surface Coatings of Asphaltic Oils, Tars, etc.

Today nine-tenths of all our State highways that have not been resurfaced have been coated and kept coated with some bituminous material and have been kept constantly patched. Where the heavy hot oil was used, it has lasted in some instances for five years, carrying a large amount of automobile travel but a small amount of heavy teaming. Under many heavy teams it has failed in a month or two. We have then used a light oil to lay the dust and prevent the automobiles from tearing the road up, and have left the stone to carry the travel until we could resurface the road.

Because of the automobile traffic on many main routes, we are now using in our resurfacing a bituminous top two to three inches deep. We have used refined tars by both the mixing and grouting method. We have used asphalts with the same methods, and we believe that use is economical and necessary on any roads that have more than 50 automobiles a day and where there are more than 50 loaded teams.

I am giving a table showing the class and character of surfaced roads that we believe will stand traffic of a certain class, kind, and character—we believe it will prove economical and satisfactory with the traffic.

1914—AVERAGE DAILY TRAFFIC

Table showing results of observations of traffic on different types of road surfaces in Massachusetts—Standard Road, 15 feet in width, gravel or waterbound macadam 5 to 6 inches in thickness, with adequate drainage and proper foundation, with 3-foot gravel shoulder on each side.

	LIGHT TEAMS, CARRIAGES WAGONS	HEAVY TEAMS, 1-HORSE	HEAVY TEAMS, 2 OR MORE HORSES	AUTOMOBILES
A good gravel road will wear reasonably well and be economical with	50–75	25–30	10–15	50 to 75
Needs to be oiled with	50–75	25–30	10–15	over 75
Oiled gravel, fairly good heavy cold oil, ¼ gal. to the sq. yd., applied annually with	75–100	30–50	20	500 to 700 or more
Water-bound macadam will stand with	175–200	175–200	60–80	not over 50 at high speed
Cold oil or tar will prove serviceable on such macadam with	175–200	175–200	60–80	50–500
Macadam will then stand but the stone wears, of course, with	175–200	175–200	60–80	500 or more
Water-bound macadam with hot asphaltic oil blanket will be economical with	100–150	50–75	25–30	1500 and more with fewer teams
And stand at least				50 trucks
But will crumble and perhaps fail with over (on narrow tires, ice, farm and wood teams, etc.)	150	75	30	
Water-bound macadam with a good surface coating of tar (¼ gal. to the sq. yd.) will stand with but requires to be recoated annually with ¼ gal. of tar per sq. yd.	100–150	50–75	25–30	1500 or more

It is assumed that all road surfaces are kept constantly patched, that before applying bitumen the road surface is cleaned and patched, and the bitumen covered with pea stone and sand or gravel and kept covered so that it never picks up.

Of course, in connection with this table it is absolutely essential that the drainage and foundation are sufficient and the material used is strong enough to carry the heaviest load which goes over the road without the road's being rapidly destroyed.

Materials That Have Not Failed

The foregoing table has been somewhat changed as the result of our experience since 1912 when I first published a like table.

It expresses the consensus of opinion of our chief engineer and four division engineers and my own best judgment.

The results have all been obtained on many miles of road where we have used a good grade of asphaltic oil, either hot or cold, heavy or light, or a good grade of refined tar.

We have had many failures on short sections of road where a non-asphaltic oil was used or a poor grade of oil or tar, and many proprietary so-called dust-layers have failed. Roads that failed have been resurfaced or retreated, but the results are not tabulated in the above table.

The table relates merely to the maintenance of gravel or water-bound macadam roads, not to bituminous macadam.

It represents our average experience on many miles of road at over 150 observation points.

Certain exceptions should be noted.

Army manoeuvers, especially large bodies of cavalry and artillery, will rapidly destroy any bituminous blanket surface.

A blanket coat of hot oil on macadam will carry a much larger number of teams if there is a ratio of two to three automobiles on pneumatic tires to each team to keep the bituminous surface constantly rolled down when the horses and teams pick it up.

But note that a very few teams on narrow tires, or a few very heavy teams every day, will destroy the surface if the load is heavy enough to shear down entirely through the surface to the stone.

If this process is repeated once or twice a day, a rut soon develops and the road becomes muddy and the bituminous surface rapidly disintegrated.

Light oil or cold tar will then be more serviceable, laying the dust while the stone takes the wear.

We have maintained a few miles of road in reasonably satisfactory condition with annual applications of a cold tar or water gas tar. They have required one-half gallon per square yard annually, and the results have been about the same and certainly no better than where we have applied two quarter gallon coats per square yard off light asphaltic oil the first year and one quarter gallon per square yard each succeeding year.

The cost for the cold tar has been more.

Invariably we clean and patch the road first and cover the bituminous material sufficiently to prevent its picking up.

We have sometimes tried dispensing with the cleaning and covering but shall not repeat that expensive experiment.

We can usually have the light asphaltic oil sprayed onto the roads by motor trucks for 1.2 cents to 1.5 cents per square yard, using one-fifth to one-quarter gallon per square yard.

The cleaning, patching, and covering costs about the same.

Maintenance Methods

On gravel roads we have found it necessary to keep them constantly shaped and patched. We drag some of our roads once a week where there are 150 or more automobiles a day. We have found on the

hills that have rutted with that traffic that it was more economical to use a quarter of a gallon per square yard, of light asphaltic oil, using the first year two applications and in subsequent years one, keeping it properly covered. Roads of this character have been extremely satisfactory with the traffic of a very large number of automobiles, certainly 500 a day, but they will not stand a large amount of heavy horse-drawn vehicles and probably will not stand many loaded trucks.

As you will note from the table given before, our ordinary maintenance which has consisted of keeping the drainage open, shoulders cut back, and the road sanded, with slight patching, has averaged about $100 a mile a year. Where the road can be maintained with light oil, the additional cost is about $250 a mile a year, or $350 a mile a year in all. The cost of heavy oil or tar on the surface where it is suitable to use it because it will stand the traffic, is about twice the cost of the light oil in the first instance, and with the patching and all that is necessary it will cost about the same figure, or about $250 to $500 a mile a year, this being on a five-year basis.

In resurfacing our roads with two to three-inch bituminous macadam top, the cost has varied from about 50 cents a square yard for a one and one-half inch top no stone being larger than an inch and a quarter, and a gallon and a quarter of tar sprayed into it, to $1.10 a square yard for a three-inch top, made of two and one-half-inch stone, either mixed or grouted with a good grade of asphalt. The tar-sand grouted macadam has cost from 90 cents to a dollar per square yard. We believe that the roads of this character will have a very small maintenance cost outside of the ordinary maintenance for a period of from eight to twelve years. I am inserting some tables showing the maintenance cost on certain roads compared with the maintenance cost in England on roads of the same character; to wit, water-bound macadam, giving the cost per mile and the cost per ton per mile for each vehicle that is going over them. This figured upon the following formula, which is substantially the same in England and France:

Assumed Average Weight of Vehicles in tons

Motor Vehicles	Runabouts		1.43
	Touring Cars		2.23
	Trucks		6.25
Horse Drawn Vehicles	Light Vehicles	one horse	0.36
	Heavy Vehicles		1.12
	Light Vehicles	two or more horses	0.54
	Heavy Vehicles		2.46

The cost in Massachusetts per vehicle per mile as shown by our maintenance cost and traffic census taken in three-year periods has been substantially one cent a vehicle per mile until we began to use bituminous binders. It now figures about eight-tenths of a cent a vehicle a mile.

Traffic and Maintenance

Quantity and character of traffic.

Economical maintenance and cost thereof.

Materials and methods to be adapted to the traffic that the road has to bear.

ENGLISH ROADS

There is a very interesting and useful paper on construction and maintenance published in connection with the International Road Congress in 1913, this paper giving the experience of five of the most competent road engineers in England.

I am printing a table showing the weight in traffic in tons carried one mile for one cent of maintenance cost.

(All waterbound macadam with or without surface tar)

COUNTY	WEIGHT OF TRAFFIC IN TONS		AVERAGE COST	WEIGHT IN TONS CARRIED 1 MILE FOR ONE CENT	COST OF MAINTENANCE IN CENTS PER TRAFFIC TON-MILE
	Per day	Per Annum	Per mile per annum		
Norfolk	39	14,200	$206.25	.70	1.42
	96	35,000	80.00	4.50	22
Warwick	185	67,500	430.00	1.60	62
	239	87,200	635.00	1.45	68
	242	88,300	430.00	2.15	46
*Kent	348	126,700	1,495.00	.85	118
Norfolk	359	131,000	366.25	3.70	26
	385	140,500	281.25	5.20	192
	390	142,300	275.00	5.35	188
Warwick	451	164,600	635.00	2.70	36
Norfolk	504	184,000	251.25	7.55	132
Kent	528	192,100	1,740.00	1.10	90
Warwick	609	222,000	1,345.00	1.70	58
	734	268,000	2,005.00	1.35	74
	736	268,600	670.00	3.95	254
*Kent	796	289,800	960.00	3.15	32
E. Sussex	984	359,000	1,665.00	2.20	44
Norfolk	1,057	386,000	1,090.00	3.65	26
*Kent	3,030	1,102,810	10,500.00	1.05	94
	3,030	1,102,810	8,960.00	1.25	80
*Surrey	5,694	2,078,300	5,160.00	4.20	24
	5,694	2,078,300	3,020.00	7.15	14
Comparison with two Massachusetts Roads					
Beverly	2,898	1,058,430	5,257.00	6.50	37
Weston	1,920	699,924	1,993.00	7.02	28

* Surface tarred.
Period of 14 years.

I have used the English long-ton but have changed the pennies to cents. This table shows that the cost on water-bound macadam roads to carry one ton one mile over the road, varies from about a quarter of a cent to one and one-half cents for the maintenance. This illustrates very well, I think, the necessity of the traffic census showing the class and character of the vehicles which use the road rather than any formula which merely uses as assumed weight for each class of vehicle.

Massachusetts Experience

We have found on our roads in Massachusetts that the largest cost of up-keep on macadam roads could come from two causes; first, automobile travel, which would disintegrate a plain gravel or macadam road in a month if there were many automobiles. This could be prevented by the use of some bituminous material on the surface, provided the team traffic was not so heavy that it would quickly wear the binder out. A large number of heavily-laden teams, of say three tons or more, would wear the binder out in a very short time. Also, a very large number of heavy loads carried on narrow tires would wear a macadam road out relatively quickly. Some of the roads that I am showing would be worn from a half inch to an inch a year if of macadam, whereas when a bituminous macadam road with a three-inch top was constructed amount of wear was very much reduced.

The necessity for knowing the kind of travel is well shown by the English tables. On one road in one of the counties it cost one and four-tenth cents to carry a ton a mile, and on another macadam road in the same county it cost twelve-hundredths of a cent. It appears from the English figures that when the cost of maintenance exceeded two-thirds of a cent a ton a mile, it was more economical to use granite block on a concrete base. The cost for annual maintenance of a six-inch block on a concrete base near the docks in Liverpool has been fifty-eight one-thousandths of a cent a ton a mile.

I am enclosing a table of some of the costs of different kinds of street surfaces and pavements in Liverpool.

Table giving particulars of experience obtained in Liverpool with different classes of surface pavement—including life-tonnage and ton miles per yard width per cent of cost

PAVEMENT	TONS PER YARD WIDTH PER ANNUM	LIFE, YEARS	LIFE TONNAGE PER YARD WIDTH	COST PER SQUARE YARD OF SURFACE	ANNUAL COST INCLUDING PROPORTION OF CAPITAL AND MAINTENANCE PER SQ. YARD	TON MILES PER YARD WIDTH PER CENT	COST IN CENTS PER TRAFFIC PER MILE
6-inch Belgium Block	524,000	18	9,432,000	$2.50	$.17	17	.058
4-inch Belgium Block	150,000	50	7,500,000	1.87	.07	12	.08
Hardwood	162,000	17	2,754,000	3.37	.25	3.7	.272
Softwood	204,000	18	3,672,000	2.12	.15	7.7	.128
4-inch Pitch Macadam	120,000	11	1,320,000	.75	.066	10.3	.096
7-inch Water-bound Macadam	120,000	1	120,000		.18	3.8	.264
7-inch Water-bound Macadam Tar sprayed	120,000	2	240,000	.25	.12	5.7	.18

Tonnages on Roads Board basis, except on exceptionally heavy traffic when it is based on estimated total actual weights.
English Ton = 2240 pounds.

Traffic and cost on Massachusetts State highways

TOWN	AMOUNT OF TRAFFIC		REPAIRS AND MAINTENANCE			CHARACTER OF TRAFFIC			NUMBER OF VEHICLES PER DAY			
									HORSE DRAWN VEHICLES			
									Single horse		Two or more	
	Total tonnage per day	Total tonnage per year (300 days)	Cost per mile per year	Cost per ton miles per year (cents)	Period (years)	Runabouts	Automobiles, touring cars and wagons	Trucks	Light	Heavy	Light	Heavy
Ashby	271	81,150	$266	0.33	16	14	65	4	70	16	5	14
Beverly (No. 1)	1618	485,220	1104	0.23	15	60	278	8	66	46	4	12
Hamilton	1199	359,730	200	0.06	15	86	334	31	75	39	2	27
Lynn	3468	1,040,430	1081	0.10	9	194	1365	13	28	19	1	14
Medford-Somerville	1332	399,570	1031	0.26	6	44	121	49	47	198	2	193
Milton	1140	342,210	592	0.17	14	15	50	0	30	77	2	88
Saugus	1022	306,660	1334	0.44	14	15	58	78	25	190	3	65
Shrewsbury	1305	391,500	510	0.13	17	76	407	17	64	60	4	36
Truro	186	55,770	143	0.25	17	7	63	1	15	14	1	3
Weston	1918	575,280	1040	0.18	15	115	533	30	167	98	5	59

* 1909 Report used and results increased 70 per cent to correspond with 1912 report. Also weight of double heavy teams increased from 2.46 to 5 tons.

Explanation of Table

The above represents actual facts in Massachusetts. It illustrates the misleadingness of statistics if read without adequate knowledge of actual conditions.

The variation in the costs shown are due to various causes, traffic and weight, toughness of stone, whether road has been resurfaced or not, good and bad bituminous materials, and proper and improper use of materials.

A study of each road will prove profitable.

Ashby, with high cost of maintenance, small traffic, can be compared with Hamilton, with more traffic and a small cost for maintenance, per ton.

Ashby, built of local stone, comparatively soft, was resurfaced with the same local stone when the road was about 12 years old, 30 tons being used to each 100 feet of road. It is a country road. It had an application of cold asphaltic oil in 1913, one-quarter gallon being used to the square yard of road. Practically, the stone had worn down one-quarter of an inch a year.

Hamilton was built of trap rock macadam and it is on a main through route. When the road was eight years old the stone had worn down about three inches, and the road needed resurfacing. Automobiles had arrived.

In 1907, one-half gallon of the heaviest asphaltic oil that can be applied cold was spread upon the road and properly covered with pea stone and gravel. This treatment was repeated for two years. Then one-quarter gallon of heavy hot asphaltic oil was sprayed upon the road and properly covered; this treatment has been repeated once. The road has been constantly kept patched and sanded when necessary. It is in better condition today than in 1907.

Beverly, with a high cost of maintenance per ton mile, can be compared with Lynn, with a small cost per ton mile. Both roads are on main routes. Both were trap rock macadam.

Beverly has a large number of heavy ice teams on three-inch tires. It was resurfaced with trap rock when the road was eight or nine years old, 30 tons of stone being used to each 100 feet of road. The trap rock had worn down one-third of an inch a year. In 1910 it was coated with one-half gallon of hot asphaltic oil per square yard, properly covered with pea stone and dust. This failed in one month under the heavy ice teaming, though the same material and methods were used on the next 20 miles of road on the same route, and the surface has stood ever since with constant patching and one-quarter of a gallon per square yard of the same oil sprayed onto the centre of the road, eight feet in width.

For the next four years the Beverly road was maintained (except where it was resurfaced) by the use of one-quarter of a gallon of cold oil per square yard, two applications being used the first year, one each year since.

One-third of the road was resurfaced in 1913 with an asphaltic macadam two inches in depth, at a cost of $1.20 per square yard, two and one-half-inch stone being used because of the heavy teams and trucks.

Lynn, trap rock macadam, connects with Parkway where only pleasure vehicles are admitted, except on local business.

In 1907, one-half gallon of hot refined tar was sprayed upon the road, and covered and kept covered with pea stone and dust. It was constantly patched, with tar and chips. It has been recoated twice with hot refined tar sprayed upon the road and covered as before.

It is in excellent condition, but note—90 per cent of the travel is motor vehicles; it has few teams and fewer heavy teams.

Medford-Somerville, a trap rock macadam, built with the two and one-half inch stone on top. A road 28 feet in width, with heavy city teaming. A stone quarry on the side crushing 100 to 300 tons of stone a day.

This road has never been in good condition since it was two years old. It always has some depressions, although it has been constantly patched and all depressions filled with trap rock. Constantly means daily. It has always been muddy.

A part of it was resurfaced with asphalt macadam this year, the portion beyond the stone quarries. The whole road needs it. It has been treated with tar. A part of it has been coated with heavy tar. A portion had three coats of one-quarter gallon each of hot refined tar, covered with pea stone, in one year. It failed, was never in good condition, and we are in doubt whether to reconstruct with granite block on a concrete base, with concrete, or to try an asphaltic macadam.

Milton is a road of the same character with many heavy granite teams going over it.

The cost has been high because the trap rock wore out so rapidly under the heavy concentrated loads on iron tires.

Saugus. Trap rock macadam on a through route with a great deal of heavy teaming, both teams and trucks.

The stone wore out over one-half-inch a year. It needed constant patching with additional stone, was never in excellent condition except when recently resurfaced.

It had two to three inches of new stone every four or five years. In 1910 it was resurfaced with three inches of asphaltic macadam at a cost of about $1 per square yard.

This has stood ever since but has needed some patching. A portion was built in the fall when it was cold and this portion failed. No bituminous work should be done in cold weather and a temperature of over 60 degrees is vastly better than one of under 40.

Shrewsbury. A through route—too much heavy hot oil was used on it before we understood how to use oil. One-half gallon per square yard was applied on two successive years.

It rolled, rutted and was always in bad condition. It has cost a good deal to remove surplus oil, smooth off the bunches and rolls and keep it patched.

Thuro. A country road, with little traffic. Built 12 feet wide of four inches of broken stone on sand, the stone being bound with clay. An experiment but a failure.

The road was constantly ravelling and needed more stone. It was widened to 16 feet. New stone was added and rolled in and it was coated with light oil in 1912 and 1913 and is now in good condition.

Weston. A macadam road on a through route. Refined tar applied in 1907—oiled with hot oil on surface in 1909 and 1910—maintained with patching until 1912 when a portion of the road was resurfaced with a two-inch bituminous macadam.

Two and one-half-inch stones of trap rock were rolled hard and about one and three-quarters to two gallons to the square yard of a good grade of asphalt being sprayed in under pressure. This was covered with the smaller stone, rolled, and on some portions of the road a surface application was sprayed of one-third to one-half gallon per square yard, properly covered with pea-stone and rolled. This cost from 90 cents to $1 per square yard. The road is in most excellent condition and we expect to have it wear 10 to 15 years with practically no patching, although we may have to renew the surface coating by spraying every three to five years. We have one road of this kind six years old, that hasn't needed a single patch as yet.

Motor Trucks and the Cost of Road Maintenance

Mr. H. T. Wakeland, engineer of the county of Middlesex which is just out of London and has a very large amount of traffic over its roads, has given some very careful figures showing damage caused to roads by motor omnibuses weighing about six tons each when laden. He took certain roads which had heavy traffic and gave the cost of maintenance (not including watering or cleaning) for macadam roads for three years previous to the motor bus traffic, and the cost per square yard for the year 1912–13. I insert a table:

Road	*Average cost per yard super per annum for three years previous to motor omnibus traffic (cents)*	*Cost per yard super for 1912–13 since the advent of motor omnibuses (cents)*
A	13.5	25.8
B	11.2	33.1
C	14.1	41.9
D	15.6	16.9
E	9.1	15.4
F	8.7	15.1
G	5.9	16.8
H	5.1	11.1
I	21.5	36.4
J	16.9	42.9
Average	12.3	25.6

This shows that the average cost of maintenance for three years before the motor bus came in was about 12 cents a square yard a year. Since the motor bus was put on the cost has increased to over 25 cents a square yard a year. The maintenance cost to carry one ton one mile in 1911–12 was 1.2 cents. When the motor bus was put on the maintenance cost was raised to 1.8 cents per ton per mile. Mr. Wakeland's opinion is that this increase was practically all due to the motor bus. The increased cost of the road up-keep has been found to be about four cents per car per mile, or two-thirds of a cent per ton per mile in the case of a motor bus on rubber tires. In many cases the macadam surface has been practically destroyed by motor bus traffic on hard rubber tires. These were macadam roads in good standard condition prior to the inauguration of the motor bus traffic and more than sufficient to carry the ordinary traffic. The road authorities should be authorized to direct which roads shall and which roads shall not be used by motor vehicles and motor buses, and Mr. Wakeland states, as do the other county engineers in England, that a license fee of $50 a year for motor trucks is entirely insufficient to pay for the increased cost of maintenance caused by the use of the trucks on the roads.

CONCLUSION

A road means a highway that can be traveled over with reasonable convenience and with reasonable effort by ordinary vehicles. Two ruts and a horse track with six inches of mud and large potholes scattered frequently over its surface do not constitute a road.

A road to be a road worthy of the name must be constructed and maintained so that it will at all times satisfactorily and economically bear the traffic which passes over it.

Good drainage, foundation whenever necessary, and a top surface always maintained so that it will shed water, are necessary prerequisites. If any one of them is missing you do not have a good road. Constant maintenance is eternally necessary; drainage must be always open, and road surfaces must always be maintained. The most economical way to maintain a road is by constant maintenance.

With modern Massachusetts motor vehicle travel, a newly-built macadam road without any bituminous materials having been used on it, will easily be destroyed in one month, so far as its surface is concerned, and will be damaged so that it will require 15 to 25 cents a square yard to put it back into condition so that some bituminous material can be used.

Roads and road surfaces must bear the traffic that goes over them. The tables I have printed show conclusively how expensive it is if materials are not used and methods are not used with those materials, so that the road can withstand the traffic which goes over it.

I think by a study of the tables and our experience, you can gather, knowing the traffic on your road, what will probably be the most economical way to construct or reconstruct your road.

With a certain volume and weight of traffic, granite block on a concrete base will perhaps be the most economical, especially for heavy concentrated loads. Thirty-ton loads on four wheels are very common near the docks in Liverpool, where six-inch granite block on a concrete base has worn 18 years.

In figuring costs you must figure what the road has to bear in tons or otherwise. Speaking in round numbers, you will find on figuring the English roads and American roads that it costs about a cent a vehicle a mile per year to maintain the roads. It would not surprise me if the same were true on dirt roads. Dirt roads, of course, will not stand very much heavy teaming, no matter if they are kept constantly patched.

This money you must have and it must be properly expended if your original cost of construction is not to be lost and you are not to find yourself saddled with a debt on which you are constantly paying interest years after the road has passed away in dust.

But you must go further than that and figure what are the proper methods, proper materials, and the best and most economical surfaces. As I have shown, for merely automobile travel, cars on pneumatic tires, you can economically and satisfactorily maintain a gravel or macadam road in the summer season by the proper use of a good bitumen and constant maintenance and patching.

You can maintain a water-bound macadam road, if the traffic is not too heavy and by too heavy I mean too much teaming, by the same methods.

You can maintain a bituminous macadam road more economically than either of the above roads when the traffic in teams or trucks is so heavy that neither of the other roads are economical. With heavy concentrated roads that will crush or wear a trap-rock macadam say at the rate of from one-half-inch to an inch a year, water-bound macadam is not economical, either with or without a bituminous surface. Bituminous macadam will be much cheaper in the end. That is, of course, provided bituminous macadam can withstand the traffic that goes over it.

With a certain volume of traffic it is more economical to construct a pavement probably on a concrete base or possibly in some places a concrete road.

You will note that the increased cost on many water-bound macadam roads in England when the motor bus service was put on was substantially four cents a mile for every mile that the buses, which weighed six tons including their load, went over the road. Proportionately a small runabout would probably cost about a quarter of a cent; a large touring car from one to two cents, and probably a heavy horse-drawn vehicle with a three-ton load would cost about the same.

Constant maintenance costs money. Our labor costs are much in excess of those in France and England. Our materials probably average the same, though in Massachusetts our stone is cheaper than the French or English imported Belgium or Welsh granite, which is practically a hard trap-rock.

You will note that all the French roads, even little country roads, cost over $100 a mile a year on the average to maintain. You will note that even the little country roads in England have cost more. You will note that the French engineers practically state that they need $770 a mile for many miles of road on their main roads to adequately maintain them; that the English county engineers spent $1100 a mile on the average on their main county roads, and that we in Massachusetts are spending $850 a mile.

These figures, of course, include not only ordinary maintenance but resurfacing when say one-half of the original road surface has worn off.

The people must be made to realize that if the original investment in roads is not to be lost, adequate provision must be made for the maintenance of the roads, and the money secured from some source.

Remember that while

> The Knights are dust
> Their swords are rust
> Their souls are with
> The saints we trust

the bonds will be presented on Resurrection Day.

MR. SUGGS: It was not pertaining to the subject but I just want to know what is the benefit to be derived from this expenditure and what you get from your streets and what benefit they are in the State by reason of having these good roads? I have heard some great stories about the tourists leaving money in New England by reason of these good roads.

MR. SOHIER: Don't come into our State and think you will get away with any of your money. The tourists leave there, according to whether they stay at the Touraine in Boston or at Magnolia in Gloucester, Mass., or some of the country hotels, $2.50 to $10 a day, and they pay for their gasoline and $1.00 to $1.50 a day for their car. Unfortunately we don't get that money for the roads. If we did, we would keep good roads all over the State. We, in New England, have got the best summer industry that anybody has got in any part of the United States except in some parts of California, and we are glad they are all coming up there wearing our roads out and leaving us their money. There is a little country town in western Massachusetts that had a valuation of $300,000. Our towns include the whole township and the town takes care of all the roads inside that township and collects both the State and county

tax as a part of the town tax. It is not a borough inside of a township, the roads are not maintained by the county; the county does not collect the tax except through the town. We maintain our own State highways. They started ten years ago improving their roads in that town. They borrowed the money; they put in at least $500 and sometimes $1000 a year and we have matched it under the State Aid Law and in the beginning we gave them all we could under the State Aid Law and with that money they got 10 miles of town highway built of gravel on a foundation where it was necessary. When they started the valuation of that town was $300,000. A few men who had come into that town increased their valuation to nearly $750,000; they have doubled the value of every acre of land on the main street and that town is appropriating some years 50 per cent of its taxes for road improvement because they say if we only can improve the roads and so increase the valuation that the schools can wait and they will have twice as much money for our schools in five years. We in Massachusetts have had town after town that has doubled its valuation within five years after the time the road was built. We have just opened up a road over the Mohawk Trail between Greenfield and North Adams and when some of the gentlemen telegraph and say, "What does it cost to build a macadam road per mile?" they'd better ask Brother MacDonald than myself. That road is nothing but a graded dirt road, poor dirt, some of it, and it is going to be maintained with a log drag. It is 16 miles long over a new location and it has cost us about $350,000 for 16 miles, without any improved surface whatever; and it is built in three towns where the total valuation of the three towns is less than $1,000,000; in other words we spent 33 per cent of all the valuation of those three towns to get a through road east and west in the northern part of Massachusetts, and there comes where I am willing to make a bet; I will make a bet that five years from now the valuation of the towns in that neighborhood, or on the line of that road, will have increased four times the cost of the road.

MR. G. L. BURGESS: So you are not burdened with the thought of losing money by building these good roads?

MR. SOHIER: Our Legislature sometimes has made a special appropriation directing us to build roads that we think we ought not to build.

MR. BURGESS: How much does this dirt road cost per mile?

MR. SOHIER: The cost on one-quarter mile section was at the rate of $60,000 a mile for grading. There were 100,000 yards of earth that came down during slides last winter. There's 75,000 yards of rock excavation on one side of the mountain; we did that at a cost of $1.50 a yard.

MR. BURGESS: Our country is just a level country; we put up about a mile a day for about $8 a day.

MR. SOHIER: You are very fortunate, sir.

MR. SWINDEL: We sent an engineer to your State in June to investigate some sand oil roads there as we called it. There is a little place in an adjoining county to us that has been built about a year and a half and it has got people in that county crazy about that class of road, and while we are in a day's ride by automobile of where the Indians are living in their native huts and we don't get any State aid, neither have we had but very little engineering aid in the roads in our State, we are not following the path of the calf that has been dead 200 years ago, and we want to know or would like to know if you could tell us anything about that asphalt oil sand road; I mean whether the sand is heated, whether the sand and asphalt are heated and mixed and put on the road hot, say, the road bed rolled and leveled off and that material put on and rolled down three or four inches thick, something like that. Do you know anything about the wearing qualities of that kind of road.

MR. SOHIER: I would be happy to send the gentleman the specifications. We built an asphalt oil sand road in 1906. It was built by what we call a layer method in a little town on Cape Cod where there was nothing but sand, the road surface was hardened with loam and clay. I think we had to use loam at that time, so that it would not rut much. On that we spread three-quarters of a gallon of hot asphaltic oil, and you can get better grades of oil today than we used then if you buy the good grades with an asphalt base, and you will have an absolute failure if you buy oil with a paraffine base. If you get Mexican oil, California oil or Texas oil from the right wells, you will usually get good oil. Three-quarters of a gallon of oil was spread per square yard, very roughly. That had about an inch to an inch and a quarter of sand put over it and another three-quarters of a gallon of oil was spread over that, then another inch or an inch and a quarter of sand spread on that, and then another one-half of a gallon of oil spread on that, then about an inch of sand put over that. That road cost at that point $1700 a mile for a 16-foot road the first year.

Now the next spring you jumped from hump to hump, you thought you had no road and you had a lot of ruts and holes and it was very uneven. It was harrowed with a disc harrow; first broken with a gang plow, harrowed and made fine with a disc harrow. If we could have used water, we would have secured better results but we did not have any water. It was shaped back, rolled in and given a little more oil on the surface. It stood us $2500 a mile the second year and we had a reasonably satisfactory road for 12 or 15 farm teams and light buggies a day and the road is on the job now and you

would not know it from some of the other roads made by a mixing process, but we have been constantly filling ruts and holes and it has cost us about $300 a mile a year to keep that road up, but no more than the macadam road right alongside of it and the macadam road alongside of it is now getting 500 cars a day every pleasant day in the summer, and it is taking them and the old oil sand road is carrying the same.

The road by the mixing method costs usually about $4500 a mile. You must get a good quality of oil, you must be sure your sand is dry and hot, about the same temperature as the oil. We are getting better results with a hot mixture. We did mix it by hand. We have had prices of 30 cents to 40 cents a square yard for the surface not including any grading or hardening the subgrade with clay or loam. We furnished oil to the contractor. That is for 4 inches thick and 16 feet in width, and on those roads we are finding it is rather better to give them a surface application of oil the first year because it is very hard to get the man who will either rake the mixture smooth or put down his shovel so that he does not get a little bit of a ripple.

The layer method costs $2500 a mile and the mixing method about $5000 for the surface.

The first method takes two years, sometimes three, before you get a good road. By the other method you get a good road almost at once. You ask how long are they going to last? They are going to last us ten years provided they do not suddenly develop such a heavy traffic of heavily loaded teams on iron tires that they cut through. They have not cut through yet, and we put them right against macadam all the way from Boston to Cape Cod, 150 miles, but with large automobile traffic, not heavy team traffic, and we are a little bit afraid of the auto trucks. We know that one truck a day won't hurt the road, or five trucks won't hurt it, because we use trucks over it ourselves, but they are rutting it a little. We hope it is not going to rut much and we hope if we have to do anything to it, we will find that we can roll stone in on hot days and thus strengthen the road and save the top. In the future we can perhaps grade out sands, use a better and harder asphalt to make practically a sheet asphalt road without too great an increase in cost.

MR. BURGESS: The road I mentioned was built in front of a hotel the man is here in town that had charge of the construction, I don't remember his name now, but while the road won't get hot enough to run or puddle in hot weather, it is not perfectly hard, it is the least bit springy, you can take your knife and cut out a piece like that and stick it back in and rub your foot over it and in a little bit you can't tell where it is, it seems to go back together. Well that road was constructed by burning all the vegetable matter out of the sand, having nothing but the pure sand and heating the oil to something like 250 and mixing it hot and putting it on the road and rolling it hot. It was mixed by hand, just a small piece.

but we've got the road craze in our county; we've got sand up there that deep.

MR. SOHIER: So have we.

MR. BURGESS: And my Hillsboro County friend is building brick roads. We are not able to build brick roads; I don't know that they are much richer than we are, but there's more of them, so I don't think we could build brick. The only material we have is a reasonably poor class of clay and we are using a great deal of that with the sand but it goes all to pieces; it won't stand, and from the way that little piece of road looks down there and what our engineer reports he brought back from Cape Cod about that road up there, we have about decided that the sand asphalt road was our best road.

MR. SOHIER: Where do you come from?

MR. BURGESS: South Florida.

MR. SOHIER: I think if you have got really a hot climate, if I were in your place, I'd use the heavier oils, I would use some of the oils that you want to heat to 300 to 350; you can still make it mix if you will heat your sand to the same temperature.

REPRESENTATIVE OF THE STANDARD OIL COMPANY: The Standard Oil Company, of Jacksonville, will give him all the information he needs.

MR. BURGESS: The stuff we are using is about 99 per cent pure asphalt; it is not an oil at all, you can cut a chunk out of it, and throw it around anywhere you please and it won't run; but now, as you see, the granite road wears out, the brick wears out, the steel rails on the railroad wear out. If this sand-oil road, this asphalt road wears out, why can't we heat some more asphalt, sprinkle some sand over it, heat some more asphalt and sprinkle some more sand over it and build up that road and keep it from wearing out?

MR. SOHIER: That is just what we are doing.

MR. BURGESS: We have great quantities of sand; if we can get some plan by which we can build a road out of sand, we are fixed. We don't have to blast up the sand, we can shovel it out.

MR. SOHIER: You want to use the coarsest, best sand you have in the bank, and if you want to do it cheaply, you want to mix it by machine, and the next thing I want to say is this, you cannot use any specifications and find them correct on your particular sand,

we don't know enough yet to know why, but we do know that some sands apparently, as far as we can tell, the same, mix very nicely and come down with 18 gallons of oil, hot, to the cubic yard of sand; we use up to 23 on other sands and when you get your road done, you want to have your material well mixed so it will pack down and won't be mealy. It ought to tamp out so that it compacts. The rule for that is as it was with the tar, spread your sand in a heap and rake it and if you've got about the right mixture of sand and oil, it will continue to crawl for quite a few minutes after you have mixed it and it stops right off after you've raked it if you have not got enough, also when you tamp it or roll it there should be enough asphalt in the mixture to make it consolidate pretty well.

MR. BURGESS: Let me ask one question: I was at a little town nearby where I was putting down a small piece of street out of this same material and noticed a man that was putting it down; he took a little piece of paper and was mixing the sand and oil hot, had it hot before he put it together and still kept it in the same pot with a fire under it, and he would take out a little of that sand every few minutes and look at it on a piece of paper and I thought from his examination that he was trying to get it mixed until the grains practically become a part of the sand. It was mealy like; then he put it down and when he put it down and packed it a little it seemed to go together all right.

MR. SOHIER: What you need is just about 10 per cent more asphaltic oil than the voids in the sand as shown by water but we have not been able to use very heavy asphalt. We tried to mix sand and asphalt with the result that it rolled up like a snow ball—I am speaking of barrel asphalt that melted about 350—and we found that we could not use as heavy a material as that and consequently we have used the heaviest standard oil, what they call B and without very much difference since the Standard Oil Company has given us *Mexican oil*; we had some perfectly punk jobs before they gave us Mexican oils. We have used California and Texas oils and got good results and no doubt any good asphalt will give good results if you have the proper sand.

MR. BURGESS: I understand that the asphalt is just used to fill up the void between the sand, and when you get it packed you have practically got a sand road?

MR. SOHIER: Sheet asphalt has only about 10 per cent of asphalt in it. The Topeka mix has only about 10 per cent of the bituminous material in it as compared to the rest of the material as in the sheet asphalt and that is about 18 gallons to the cubic yard, but it swells one-seventh with the heat so that it would make 19½ hot.

MR. BURGESS: The specifications I think we have call for 18 gallons to a cubic yard of sand.

MR. SOHIER: I would like to say to any of the other gentlemen here that we have some of the best roads I think that are built anywhere, that are built by the same method exactly that I have been describing, using hot asphaltic oil with gravel, clean sandy gravel, grading that gravel and they are very much better than the sand roads because we think they will take any amount of travel. We use a good clean sharp gravel and they have been down 7 years and don't show a pimple yet.

A MEMBER: Is the sand on the Boston and Cape Cod road marine shell sand?

MR. SOHIER: It has no shell in it; we tried to get a coarse sand and not a fine sand; it is fairly sharp but it really has several sizes of sand; we get it out of the bank, don't take it off the beach. We have one place where we could take it off the beach but there it is an original sand bank which was originally marine sand but has been in the bank a great many years now. It is much sharper than the sand on the beach. The success of the road depends on the quality of the sand in my opinion. You should try experiments first and so find out if the sand and oil will work and what particular sand and particular oil will give the best results. Then use that.

REPRESENTATIVE OF STANDARD OIL COMPANY: If our Florida friend will write to Watertown, Florida, they have just put down that kind of a road there this summer and he will get information that will help him.

MR. SOHIER: I think there was some put down by the Lane Construction Company a little south of Tampa this year, also.

MR. SWINDEL: That road you put the oil on was clay, hard surface, it was not sand like we have in Florida.

MR. SOHIER: It's just the same, sir, if your sand is coarse and sharp. All we use the clay or loam for is just enough in the sub-base so that when we spray the oil on and when the oil team goes on to the road, it won't rut it as deep as it used to rut the sand. When we sent an oil team over the old sand roads it took four or five horses to drag it with the result that when you looked at the road you found a whole lot of oil in the rut and a whole lot in each horse's track and got little drop of oil all over the rest of the road. All this had to be harrowed and broken up and mixed and rolled back to get a road. Now after we have hardened the road we can spray

three-quarters of a gallon of oil to the square yard and have it very even and I have seen a road with only one coat of oil that stood the traffic for quite a little while very nicely.

MR. SWINDEL: Do you have a heater in your tank to heat the oil?

MR. SOHIER: Sometimes, but we usually heat it to 275 in the tank car so it spreads about 250 on the road and we also use a pump so that we can get on three or four loads a day and in that way save quite a lot of money. If you can get good clean sandy gravel so that you can use inch and a half stone graded down to clean sharp sand, you will get a road that I think will wear as well as asphalt pavements under country traffic.

A MEMBER: May I ask what is the heaviest steel wire traffic that goes over the Cape Cod road?

MR. SOHIER: The heaviest probably is 3 tons, but there are very few of them. The ordinary traffic is the little country traffic that farmers and fishermen have around there and most of them are single horse wagons. If you will write me, I will send you the traffic on that road, exactly what it is.

MR. SWINDEL: We are going to build a quarter of a mile in each commissioner's district in our county, of this asphalt sand road and scatter it in different places over the county so that the people of the county can see it, and of course it will be built on different classes of ground you know and it will be subjected to different kinds of traffic and we are going to put in a quarter of a mile in each commissioner's district, just for a test to see how it will look.

MR. SOHIER: Build it 16 or 18 feet wide, otherwise they will cut in on it, and crown it one-third of an inch to the foot, only and not more—three-quarters of an inch to the foot always makes a rut, because every one straddles the crown.

MR. SWINDEL: The clay has been put down and it has rutted out, knocked into holes. We thought to level that off and put this material on top of that.

MR. SOHIER: I don't think you can mix it with any sand that has clay in it, 5 per cent clay in the sand will spoil your mix.

THE CHAIRMAN: Are there any more questions that you gentlemen would like to ask?

A MEMBER: I would like to ask Mr. Sohier what kind of asphalt he uses with that gravel road, whether it is a penetration or mixing method of surface?

MR. SOHIER: We have a lot of gravel roads, have had oil surfaces on the gravel for some time and they work well. That gravel mixed road is put on hot, an inch and a half, stone in the gravel about 50 per cent stone down to a 100 mesh sand, and in one case where we were using broken stone on the bottom, we used the stone dust and considered it rather better than the sand, but we had to go up as high as 23 gallons of oil in one pit and 20 gallons in the other to get exactly the same mixture, and we use mostly a heavy grade of California oil, also some Texas, some Aztec, some Montezuma and some Standard oil right alongside, but just in short sections to see whether they were or were not what they were sold to be. Some are not. By and by we will tell you.

A MEMBER: Did those oils show any percentage of paraffine?

MR. SOHIER: No sir. Our specifications do not allow any paraffine, but I do think there is quite a difference in oils of the same specific gravity, in the way in which they will last without crawling at the end of three or four years. I think the cut-back, taking the top and bottom and getting the asphalt, is less likely to crawl than an oil that is refined down to a certain point, leaving the various oils in between the top and the bottom, but I think the thing we all know the least about, despite anything the Standard oil people or any other oil people will tell you, or anybody else, is bitumen, and if you get bitumen that will stick to your finger and put a pencil in it and can't take it off without cutting off the wood, you are getting a pretty good bitumen; and if you can wipe it off with a paper, you can bet your bottom dollar it is a lubricant and not good for road purposes. If it is long and stringy it is good; if it will stick to your finger or a pencil it is good, and if it won't stick it is not worth a cent.

THE CHAIRMAN: Are there any more questions? We have spent a very profitable afternoon and I want to say that I am very grateful to you for the interest you have shown. I hope that you will all be here promptly at 10 o'clock tomorrow morning.

November 12, 10 A.M.

GENERAL WM. T. ROSSELL IN THE CHAIR

THE CHAIRMAN: Gentlemen, the meeting will please come to order. I have here a notice to be published, that State and Federal highway officials and ex-officials will meet at 3 p.m. in the moving picture room. This does not apply to other than State and Federal officials. We have some telegrams that the Secretary will read.

THE SECRETARY: I have here a telegram addressed to the Secretary of the Road Congress which reads as follows: "The United Daughters of the Confederacy, 100,000 strong with chapters in 34 States of the Union, ask that the Great Highway to be projected through the South from Richmond to Santiago be named The Jefferson-Davis Highway, in which case they pledge their support to the same.—Mrs. Walter D. Lamar."

We have also another telegram reading as follows: Regret exceedingly unexpected business arrangements prevented my being in Atlanta this week," Mr. Paul D. Sargent, State Highway Engineer of Maine. I want also to announce that the annual meeting of the American Highway Association for the election of officers and for the transaction of such other business as may properly come before it, will be held in this room tonight at 8 o'clock.

THE CHAIRMAN: The first thing on the program is an address by Mr. C. J. Bennett, State Highway Commissioner of Connecticut on System in Road Management.

SYSTEM IN ROAD MANAGEMENT

CHARLES J. BENNETT

Highway Commissioner of Connecticut

In consideration of a topic of this character, it must be realized that there are certain principles to be applied in organizing or systematizing a highway department, which can be applied generally to the problem wherever a department of this character is to be formed. Further than that, we cannot go. The particular methods of accounting, the minutiae, the forms, types of books, methods of reporting and recording reports are in every instance a peculiar problem to be solved locally and in the manner best fitted to give a solution of the peculiar difficulties which arise on account of position and magnitude of the department geographically or financially.

Having in mind, therefore, that the detailed phases of the problem are local, there will be no endeavor in this paper to outline an ideal

system of accounting, reports and records for a highway department, for such a system would apply probably only to that particular department with which the writer is more nearly familiar. There will be, however, an attempt made to show in a general way, what, in the estimation of the writer, are the broad principles which can be applied to systematic management of a highway department, whether it be town, city or state.

In the first place, it is necessary to realize that there are two results to be secured:

First, the proper and economical spending of a certain amount of money in the way best fitted to serve the general public, and

Second, the presentation of the method of spending this money to the public, so that it may be thoroughly informed as to how its money has been apportioned and what results have been reached. Such a record or report made to the public should be in simple language so that the most uninformed may understand the results desired and the ends achieved.

In connection with the first proposition, i.e., the spending of money to get the best results. The first requisite in organizing a system of this kind is the record or system of bookkeeping which should show at all times, the condition of the accounts and keep a check on the expenditures made for specific purposes. Such a system should be simple and familiar to all the employees of the department and should show graphically, at a glance, the amount of the appropriations made for specific purposes and a summary of the definite projects on which this money should be expended with the total weekly or monthly expenditures for the purposes defined. This information should be available to all the employees and should be so plain as to make it possible for a change in the personnel of the office force without a consequent confusion arising from a complicated and abstruse system of accounts.

In connection with this system of bookkeeping and system of reports of work necessary, the orders for the work to be done should be immediately compiled and entered in the books so that the disbursements may be kept up to date. There should be no possibility of verbal orders which would call for expenditures of money without an accompanying written report and order, which should be entered at once in the ledger. This system of accounts should provide also for a periodic statement of the financial condition of the department, which statement or balance should show not only the cash available, but also the actual amount available after all the liabilities, bills and debts of the department were paid.

Having formulated such a system of accounting, a force of employees should be organized in such a manner that the system of accounts may be followed and in such a way also that the general idea of spending the money economically and well be firmly established.

The first idea which should be applied in the organization of a

highway department is the military system, that is, the department should be subdivided so that each part might have certain duties with a definite amount of money to spend. Each subdivision should report directly to the superior officer and through this superior officer to the military head. The organization should be such that no orders should be passed around a subordinate, but should rather go through a subordinate. It is quite necessary in dealing with a force of any magnitude that the rank and file should know the purpose of the organization and the wishes of the chief. In other words, the department should be imbued with the spirit and aims of the man at the head, for in this way each man will work, so far as is possible, along the same lines and the results gained will be more nearly uniform and standard.

An effort should be made to build up patriotism in the department, which should work for the betterment of the road system rather than for the personal benefit of the employees or of the political party which is responsible for the appointment of members of the department. A modified civil service system is a good thing, in that it makes the men more sure of their positions than under a political system. Such a civil service should, however, provide for the removal of employees by the head of the department without applying to any outside body, such as a State or Municipal Civil Service Commission. The whole idea of such a department and the organization of the force, should be to secure the right men for the right places and keep them there while they give good service. There is nothing which can disorganize a department so much as the right of an employee to apply to some outside body which has no knowledge of conditions and which can only judge of a man's ability or his right to hold a position, by an examination on his technical knowledge or by a brief hearing. The measure of a man's value is in the results he gains in actual service and knowledge of a man's ability can only be secured by the record of his achievements from day to day.

In the organization of a force, a chart should be prepared showing the connection between employees, showing to whom an employee should report and stating distinctly what his duties shall be. The best results are to be gained by delegating authority to a man and placing confidence in him, having in mind the theory that men are by nature honest and will endeavor to do right and gain good results if given the opportunity. Allowance should be made for honest mistakes and a careful record kept of such mistakes so that a man may realize, when removed, that the reasons for his removal are sound and based on results showing his lack of ability.

In selecting employees to deal with the public, men should be sought who are tactful, intelligent and polite in their intercourse with people. The employee should be instructed that at all times it is necessary for him to be fair and reasonable and to keep his temper. A public employee is a servant of the public and in his dealings with citizens,

should realize this fact, but he should also be firm and not afraid to refuse an unreasonable request.

Given then a system of accounting in the organization, the members of this organization must bear in mind that if they are kept informed as to the purpose of the department in which they work, they should on their part, keep their superiors well informed of their own movements, the amount of work done and the character and cost thereof. In other words, a method of reporting work should be established and kept which should give plainly and simply, all the necessary information as to the actual physical operations carried on by the employees. The local situation will govern the extent and frequency of such reports but they should show primarily and in a clear way, the work which the employee is trying to do, the probable cost of the work to be done before it is started, and from time to time the actual cost; including remarks as to the success or failure of any particular experiment. There should not be an endeavor to make complicated reports which should show minutiae to the point of the ludicrous, for a system of reporting which becomes so complicated that it is not simple of understanding, fails utterly in its purpose.

The recording of reports in connection with the accounting system should be made in such a manner that through these records the outsider, either layman or professional, may secure information as to the comparative cost of certain classes of work, the success or failure of certain types of roads and the financial value of expenditures for certain specific purposes. For instance, it might be possible to demonstrate in a certain instance, by a system of records that a larger first cost of construction would be very much more economical eventually than a small first cost with a corresponding large charge for maintenance in future years. The system of records should, therefore, show the ultimate result from an expenditure, which ultimate result should be gained from records made over a long term.

The above discussion has covered mainly the first principle, which was stated, namely, the endeavor to get good work with the money appropriated.

A road department has, however, the duty of presenting its operations to the public eye, not only as results on the roads themselves, but in the success or failure of the department as a financial proposition. This presentation must be made in the form of a periodical report to some superior body, as the mayor of a city or the legislature of a State. The writer finds, in perusing many of the reports made, that there is an entire lack of system in presenting the information, and no effort made to make the report clear. Most reports are made in such a manner that an expert accountant would be needed to find out results gained and even then, these results would be of little value. The spirit shown most in reports is that they claim general excellence for the department and try to justify its continuance. Certainly there are some failures made by roadbuilders, which

should be reported for the good of the work. Reasons for failure should be stated, whether the failures be financial or physical.

It is quite possible and necessary to make an annual report which is readable and interesting to the layman. The text portion of such a report should be written in plain English without technical terms and with general results stated broadly and succinctly. Tabulation of records should be made as simply as possible and the cost per unit should give, not only definite figures, but should state furthermore, just what details were included in the units of work done. For instance, in one locality maintenance of roads does not include the oiling of the surface, while in other reports, this oiling is included, which, of course, makes it impossible to compare the two costs, and for this reason, and many others, as stated above, the reports should show definitely what details are included under each heading, and the cost might be analyzed accordingly.

The above is designed to open up a general discussion on the value of system in road management.

The writer wishes to make clear again that there is no question in his mind that the system should be simple and operative rather than complicated and unwieldly. The simpler the method of bookkeeping, organization, reporting and recording, the more successful will be the results in spending the money economically and well and the more successful will be the opportunity of the official at the head to present his information so that it will be of benefit first, to the general public, and, second, to the profession of which he is a member.

THE CHAIRMAN: Mr. Paul D. Sargent was to have opened the the discussion on this paper, but as he is absent, the subject is open for general discussion.

MR. T. HUGH BOORMAN (of New York): I trust that all our meetings will have some practical result. I believe in work and not too much wind. There is one most important feature in Mr. Bennett's address which every man here and every association connected with us should endeavor to have carried out and that is the most necessary method of conducting the business of the Highway Bureaus, of positively discharging any employee who is not worthy of filling his position. I go back to the time of our worthy chairman's predecessor, General Newman. When he came to New York we were inflicted, as another gentleman of the corps, General Benham, was inflicted, with these awful civil service employees. General Benham threw up his job because he had such a lot of utterly indifferent, inefficient men whom he had to employ. Now we should in every way endeavor to get ordinances or laws that the administration of the Bureau of Highways should be positively in the hands of one chief without any recourse whatever. Any man decided by that chief to be inefficient should be instantly discharged. You had

occasion recently in Philadelphia, in regard to licensing of engineers, to bring forward that statement, but while we believe to a certain extent in civil service, we suffer more from it than from any other source.

MR. KING (of Memphis, Tenn.): This is a part of the program, gentlemen, that I am very much interested in. We have in Shelby County, Tennessee, a commission form of government, as well as that form for the city, and I happen to be connected with the county government as chairman of that commission. We had some old method of conducting the public funds and it took us quite a good while to get rid of that system and I find, as an economic proposition that there is nothing so very advantageous to the management of your public funds and bridge building and road building as a public system of accounting, as well as a perfect system of purchasing. Everybody had been purchasing, even down to the lowest man in the employ of the county, whatever he needed, but that is not so now. One man who was handed down to me for political reasons, when I said to him—at the head of the bridge department—"You must come through my office for everything you want," got mad and said, "I have lived in this city all my life and in this county, and I never had to get an order for anything in my life; my word has always been taken." I said to him, "You can either adopt this system or quit." The result is that in the bridge department we have saved 47 per cent in one year's time by having a perfect system for purchasing. We have a road department and on my desk every morning there is a card from the foreman of every bridge crew, a card from the foreman of every dirt road crew, a card from the foreman of every turnpike crew, stating exactly what work was done the day before. For instance, if it is a bridge crew, they state exactly the bridge that was being repaired or rebuilt, where the lumber came from, how much old lumber was used and how much was thrown away, and from the dirt road department, how many miles of road work the day before, or fractional parts of a mile, were constructed, how many men employed and how many mules were in commission and how many out of commission, and from the turnpike department, the same way; so on my desk every morning I have a report from every man and at the end of the month I can tell whether one man in the dirt road department is costing me more than for other crews of like character and like equipment; I can tell the same way in the bridge department what it costs per foot or per hundred feet to work that lumber; so then it is an absolute system and that system is reducing the cost of repairing and building in that county from 25 per cent to 47 per cent. So gentlemen, there is not anything that so concerns us and the taxpayers of this country, there is not anything so pleasing to the taxpayers as the very question that the gentleman has been discussing and I think we need to study it and get a system all over this country that shall be workable and plain, that the people may understand.

MR. J. W. BARNETT: The gentleman has just outlined in a very clear and interesting manner his method of record keeping, cost keeping; he stated that before any supplies could be purchased that orders would have to be issued. I would like very much to have him explain to us his method of purchasing supplies, whether through a purchasing agent or whether it is done through the chairman of the commission; that to me is a very interesting point.

MR. KING: I do the purchasing myself, as chairman of that commission. Every dollar's worth of goods of the county, amounting to $7000 or $8000 a year, I purchase myself.

MR. E. P. BALA (of Atlanta, Ga.): Order is the first law of nature. God in making the world had a plan. Everything must have its plan to reach perfection. In road building as in everything else, there must be system. If you want a road, the first question is, is it a public utility? Is there traffic enough to justify that road? How is it to be built between two points, and you must get a doctor. An engineer is a doctor of highway roads. You must employ a competent engineer. He must go over the road carefully in a preliminary survey. If I was going to build a railroad or a highway from Atlanta to Macon I would want to know the difference of elevation between those two points; I don't want to crawl up higher than Atlanta a dozen times. In going from Atlanta to Macon I want to go by a uniform down grade because Macon is lower than Atlanta. The location of a road is an important consideration; you don't want to sacrifice grade to curvature or curvature to grade, but you want to find out which way the main traffic will go when this road is built, and want to build with reference to grades, and the way the traffic is moving. You want to put as few curves as possible and get as near an airline as possible and put no heavy grades upon this road. If you put curves, pursue the same policy the railroads do, make circle curves going from a tangent to an easy curve or a little higher, and then to the body of the curve, and all in the same way. Another thing, you want to prepare to procure the right of way before you strike a lick in excavation, you want to be sure that you get a wide enough right of way for all the purposes that road will be put to, put it a little wider than the present necessities call for, give it ample room, and whenever you strike a curve you should have the right of the property from each end of the curve and clear that right of all trees to give access to sight; put no dead men's curves on it. Then again, after your location is made, be sure you get an engineer that is capable of carrying out the instructions on this road, give him some limit, give him the idea of thought; don't grind him down by conventionalities. I was once called upon to locate a line from Chicago Junction to Chicago. My instructions were the simplest ever had—"as near an airline as possible, pay no attention to towns, we are building it for a freight line." Those

were simple instructions. The engineer was on his mettle and we got 271 miles out of 269, all roads crossing either under or above, for safety. It's the same way with our roads here; when you hit a railroad, if possible, go under or go above. Then the next question in road building is the surface; get a good cross section and maintain it, and if your traffic is very heavy, put on the best material you can find, using economy; and again you want to keep that surface up to its original character. If a sharp tired wagon goes over it and cuts it, you want to be there the next moment and repair it. If it makes a hole, the next wagon that comes along hammers it deeper and so on; heavy traffic comes along and makes a terrible hole, one that is dangerous to the public. Then again you want to have system in everything, system in keeping accounts, system and a head to every department. This thing of every man being a head is all wrong; there must be one head. A man that cannot do his duty under any circumstances does not deserve the position that he holds.

THE CHAIRMAN: I received this notice:

The following resolutions were unanimously adopted by the Georgia Women's Suffrage League, Mrs. Francis Smith Whiteside, President, at their meeting Wednesday afternoon:

Resolved, That the Georgia Women's Suffrage League heartily endorses the movement of the American Highway Association for good roads in Georgia and that the League stands ready to coöperate with the movement in all their undertakings.

Next on the program list is a paper on "Street Construction and Maintenance," by Henry W. Durham, Chief Engineer of Highways, Manhattan, New York.

SOME PROBLEMS OF STREET CONSTRUCTION AND MAINTENANCE AT HOME AND ABROAD.

HENRY WELLES DURHAM

Chief Engineer of Highways, Manhattan, New York City

When recently the invitation was received by me to discuss the subject of street construction and maintenance, it seemed like asking for the writing of a cyclopoedia in two weeks. Most books bearing this title are at best merely superficial and all that can be said in a few minutes, is to touch on a few points which may have a passing interest to those, who like the speaker find the attempt to satisfy public demands, always hampered by a general public ignorance even among those considered well informed, as to what is the best or the standard practice in other communities than their own, as well as to why many conditions about which complaint is made, cannot be immediately changed.

It must be recognized that the problems of our largest city as a whole, are not always those of others of a lesser size, but usually some of its subdivisions can be found to parallel almost any other municipality, the Metropolitan District having grown by the consolidation of former distinct units varying from villages to large cities, many of which still continue their individual characters.

Any tendency on the part of the speaker attributable to the alleged insularity of New York, may possibly have been modified by beginning his paving career as engineer of our oldest American city, Panama, and by a course of investigation of municipal paving conditions, both in European cities and in those of our country.

Some years since, in a report made by a citizens' committee on New York pavements, expression was given to a popular idea which still prevails that the pavements of the City of New York are, and probably always have been, very inferior to those of first-class cities of the old world. As the facilitation of public communication by its highways gives as good a measure as is possible of the prosperity of a community, a short statement of some European and American street problems and the methods of solution employed, will be of more interest than purely local statistics, even though now progress in the cities of the former continent, may be temporarily interrupted; because the duration of that interruption and its ultimate result may, to a great extent, depend on the degree of perfection attained in highway communication in the various countries involved.

The work of pavement maintenance abroad, has been largely dropped for the present as is witnessed by a recent communication from the director of the French Mission of Engineers to the United States of America, now in Paris, who writes me regarding his inability to furnish certain data which had previously been requested, due to the fact that he "is becoming more and more busy in quite different lines." This censored bulletin seems to indicate that the famous corps of Engineers of Bridges and Highways is not at present occupied with its ordinary civilian problems.

The statement may be axiomatic, but it still seems to require reassertion that though road construction and maintenance have been from the earliest times to the present of primary importance to all countries that have attained important rank, they have radically altered in conditions in the past quarter century due principally to two causes: the first of which is the motor vehicle; and the second (in so far as relates to the problem of municipalities) the increasing importance of utilizing the space immediately beneath the surface of the streets for public utilities. These are required to an extent increasing as rapidly as the density of population in working, trade and residence centers, which involve a demand for the distribution of power as well as for means of communication and transportation requiring large installations of lines for telegraph, telephone, water supply, gas, sewers and rapid transit railroads.

City streets developed from first being that portion of a highway between built-up rows of houses and the adjacent communicating spaces between outlying buildings, and were gradually, after many centuries, elaborated by the separation of pedestrians from vehicular traffic. Up to the middle of the past century a pavement, consisting of stone blocks laid directly on the ground surface of the street, was considered satisfactory in all cities of Europe and in the older cities of this country. At the present time such a surface is used in a great part of the streets in every important European city.

An essential difference between our cities and those of Europe lies in the fact that, due to our broad growth, our streets are to a very large extent on regraded ground, whereas in many of the older cities of Europe the streets have occupied their present location for hundreds of years, have been only to a slight extent excavated and refilled, and furnish a durable unyielding foundation for the paved surface. It is safe to say that not 10 per cent of the area of streets of the great cities of Europe are paved on a concrete foundation, a notable case in point being the city of Hamburg where some of the finest stone pavements in the world, having flat heads and close fitting joints, are laid directly on a sand foundation, and Paris, which has $\frac{1}{11}$th of its stone streets on concrete. But whereas most European streets of whatever type have a permanent surface suitable to the existing conditions, those in our cities not yet provided with a concrete base are largely of a temporary and unsatisfactory nature, awaiting permanent improvement.

For new pavements in important thoroughfares concrete foundations are regarded as essential by engineers on both sides of the ocean. As to the requisite thickness and proportioning of the concrete there are as many practices followed as there are cities. The minimum thickness abroad, and a figure which corresponds to that of many of our important towns, is 4 inches. This, up to July of this year, was regarded as adequate in Brussels for the traffic previously contemplated. Probably the average abroad is about 6 inches. Berlin and Paris have foundations running from 6 to 8 inches as do Liverpool and Birmingham, while London goes to a maximum of 12 inches on its main streets founded on an alluvial soil.

Its composition in different places varies between wide limits. A cheap and easy form of criticism occasionally indulged in by those well enough informed to know better, is to direct public complaint against some specified case of foundation concrete work in New York, often based on the authority of some eminent engineer (name not given) who observed the work on his way through the street and stated that the amount of cement employed was inadequate and the materials not properly mixed to produce a durable foundation. On such criticisms argument has been based that the proportioning of such concrete in Manhattan at the ratio of one of cement to three of sand and six of stone or gravel does not produce a strong enough mixture.

For purposes of comparison the following table shows some of the varying proportions abroad:

Cement		*Fine Aggregate*	*Coarse Aggregate*	
London:				
City and Westminster	1	.....	6	Thames ballast—unscreened river gravel
Lewisham	1	.....	7	Thames ballast—unscreened river gravel
Battersea	1	3 sand	5	clean gravel
Liverpool	1	6 crushed slag	3	broken stone, 3-inch gauge
Paris	1	3¾ sand	7½	stone or gravel
Berlin and Charlottenburg	1	.....	8	fine gravel and sand
Hamburg	1	.....	7	unscreened river gravel
Vienna	1	3 sand	5	gravel

First quality cement is the same on both sides of the ocean, but it should be noted that, except in the best work, in the continental cities the contractor is usually permitted to use on streets of secondary importance a slag cement of inferior grade and in some cases a lime mortar, so that the concrete would be of much less strength than the proportions indicate. It is frequently constructed of bank gravel, no separate measurement of sand and gravel being made, but the proportion of cement added to the run of the bank. Often the old macadam road material is used, when a street is repaved with an impervious surface, to furnish the material for concrete, it being screened at the side and mixed with cement and sand.

Work of concrete mixing is done almost entirely by hand, although machinery has been introduced in Germany to a small extent. The subfoundation is rough graded with about the same accuracy prevalent in New York, but it is more usual to finish the concrete surface smooth. It is commonly laid between forms set transversely to the axis of the street at intervals of about 15 feet, materials being turned over on a mixing board between these forms directly into place. Final finish to the surface is then obtained by drawing a straight-edge across the width of the street, the concrete being laid mixed wet enough so that finer material flushes to the surface and produces a fairly smooth finish under the straight-edge. Where this method is not followed, the forms are placed longitudinally and a finish obtained by drawing along them a template formed to the proper transverse section. Where wood pavement is to be laid, particular attention is given to obtaining an accurate smooth surface and a certain amount of hand-smoothing is sometimes employed; but it was noted in London and in other cities that by employing the method of accurately setting transverse strips to the surface grade on narrow widths of concrete and then drawing a straight-edge or a screed along on these adjacent strips, between which the work of mixing and placing was being carried on, a sufficiently smooth surface was obtained with very little subsequent plastering. For asphalt and granite it is not attempted to obtain such smooth

results, but usually a more accurate surface results on all classes of work than with us, though it is at the sacrifice of speed. The quality of the concrete is not superior to that now being produced in this country.

In summary it may be said that Europe presents to us no solution of the pavement foundation problem different from or better than those known in this country, and that there is substantial accord in all important cities about the present-day necessity of concrete foundations for durable pavements.

A most difficult problem confronting the highway engineer today in city work is to make a correct decision as to a suitable form of wearing surface to be adopted, one that shall if possible combine the very contradictory qualities demanded by the different interests involved. Horsedrawn trucking interests, which are still with us to a great extent, desire a surface which shall furnish a good foothold for animals in addition to giving good traction for wheels; the occupants of adjacent buildings desire absence of noise and cleanliness; while the necessities for access to subsurface structures require the possibilities of frequent opening and easy restoration to a condition substantially as good as the original; further, the taxpayer demands a form of construction that shall combine a minimum of original cost and subsequent maintenance with a maximum of durability; and the general critic calls for the discovery of some hitherto unknown perfect type and refers us to the great cities of Europe in which, as he knows from personal observation during the few hours he spent in each and on the few blocks which he visited, the pavements are perfect, repairs never required, openings made during the night and restored before morning—all at practically no expense to the taxpayer.

Investigation does not bear out these claims, nor unfortunately does it discover the desired solution. The municipal highway engineer everywhere abroad, as in this country, is trying to satisfy the same conditions with the same limited success. The best to be said is that general experience has reduced to a very few classes the number of desirable wearing surfaces for city streets, and the selection of the most suitable for each particular case is usually arrived at by a process of elimination, taking the one that presents the fewest drawbacks.

The original street pavement, and that which is used over more than half the area of all city streets in Europe at the present time, is some class of stone block, ranging in quality from the rough cobblestone pavement which has been generally discarded in our cities but which is still very prevalent abroad, through various grades of squared block to one laid with hand-dressed blocks with joints of less than $\frac{1}{4}$ inch and heads absolutely plain, found to a very limited extent in such cities as London, Liverpool and Birmingham and costing from $5 to $10 per square yard.

The most frequently used type at the present time in the cities of

Central Europe is that known as the Belgian block from its prevalence in that country—a type superseded with us; but when laid with the greater care usually found abroad and on streets little subject to excavation, quite satisfactory though noisy. These blocks are generally laid without foundation, with joints not exceeding one inch in width and a surface much smoother than that of our poorer type of similarly paved streets.

Another variation of this class is the type of large slab block pavement employed in Italy and, to some extent, in Austria, composed of stones measuring sometimes as much as 18 x 24 inches on the top with a depth of about 6 inches, laid with close-fitting joints and combining wearing surface with foundations. Such pavements, while extremely slippery even when the upper surface of the block is grooved, seem to give entire satisfaction in the cities where they exist. The material employed for the block is, as with us, either a trap rock or a granite presenting varying degrees of hardness in accordance with the material available for the locality in question. Only in exceptional cases is there any attempt made to classify the stone according to hardness for use on grades of various steepness.

The latest improvement in stone paved streets, and one occurring simultaneously on both sides of the ocean, is the reduction of the depth of the blocks over a concrete foundation to a dimension not exceeding 5 or 6 inches, and the use of accurately cut square-fitting stones laid over the foundation in a cushion of minimum thickness in virtual contact, so that when the joints are solidly filled with either a cement grout or some bituminous material they shall present no edges to wear round and produce an irregular noisy surface under traffic.

In most European city streets where none of the above kinds of stone pavement prevail, some form of macadam or Telford roadway is used, either the old water-bound surface or, in the more modern construction, with the addition of a bituminous filler.

Finally, on a limited proportion of the better class streets, and these are in the area commonly seen by the tourist, there are found the quiet and smooth surfaces—sheet rock asphalt and, to a lesser extent, soft or hard wood block.

Making a comparison with those of our American cities which have devoted much attention to modern repaving in recent years, it would seem as if the above classification should be reversed both as to quantity and quality; but it is based on accurate figures for the leading countries of Europe. A tabulation of the relative quantities of different classes of pavement in the first seventy-six cities of Germany shows this to be the case. The list includes all cities having a population of 50,000 and upward or an aggregate of more than 15,000,000, which is nearly one-fourth of the entire country. They have a total area of paved carriageway of approximately 110,000,000 square yards divided as follows:

Stone block, all classes	60,000,000
Macadam, telford, gravel or earth	35,000,000
Asphalt	9,000,000
Slag block	2,000,000
Wood block	1,000,000
Small cube stone	2,000,000
Miscellaneous	2,000,000
Total	111,000,000

That is, more than 50 per cent is stone block and 86 per cent either stone block, some form of crushed stone or dirt, leaving 14 per cent to divide among all other types. Of this remainder nearly two-thirds are sheet asphalt, and all other kinds occur in only relatively small quantities. These figures are from the official report of 1912 and consequently subject to slight revision, but show substantially the relative importance attached on the continent of Europe to the various classes of pavement surface. A statement of these facts does not in any way detract from a recognition of the large extent of elsewhere unequalled wood surfaced streets in London, nor of the very fine asphalt pavements in the newer parts of Berlin and on the boulevards of Paris and Vienna. Citizens of none of our leading American cities would be contented to have in a residential street macadam and stone block, to the extent to which they prevail abroad; and, consequently, lessons drawn from foreign practice are valueless to us in this respect, while we have already learned to construct stone and asphalt pavements of a quality equal to their best.

The selection of the types of pavement to be adopted in a great city, while limited in a large degree to the three classes referred to, can not be laid down in any set of rules whose observation will lead to the satisfaction of any community. Local climatic conditions, economically available sources of supply, as well as the relation to each other of the different localities for commerce, manufacture and residence and, finally, the financial resources of each city must all exercise too great an influence to make the practice of one valuable as more than a general example for another.

With regard to noise, more attention is paid to this question in city streets than previously, and the old type of wide joint stone pavement has been completely ruled out. On our modern granite streets such noise has been very measurably reduced. Motor vehicles are as quiet on them as on asphalt or wood, but there is inevitably a certain amount of rumbling from steel tires and horses' hoofs, and if the most noiseless surface is desired wood must be adopted. In view of its greater life, however, and consequent ultimate economy, its lessened slipperiness and almost equal ease for maintaining in a clean condition, the lessened amount of repairs required and the fact that it is the only surface in which street openings can be restored to a condition equal to the original, modern smooth-dressed close-fitting granite pavement on a concrete foundation, its joints filled with bituminous material, has been decided to be most satis-

factory for those streets in the borough of Manhattan having the heaviest traffic where the general city noises from surface and elevated railroads and the other sources of disturbance of a city render any condition attributable to variations in the type of pavement negligible.

For a fairly heavy and dense traffic in wide street subject to infrequent cuts and having a level surface or only moderate grade, there is no question but wood pavements can be laid that are eminently satisfactory. They require the most careful attention for maintenance and perhaps vary in quality between greater extremes than any other type. Nothing finer in the world in pavement surface exists than can be seen in London on the Mall from the Admiralty Arch to Buckingham Palace, a street that is subject to a fairly dense pleasure traffic, or on Whitehall, the Strand, Piccadilly, or many other of the adjacent streets in the heart of Westminster. On the other hand, some of the worst wood surfaces encountered in any city can be found within two or three miles of those just referred to, illustrating very clearly the absolute necessity of constant attention for maintenance and the selection of the best class of wood and workmanship for this type of construction.

For the combination of economy, cleanliness, absence from much noise and satisfactory surface for the general city traffic in the residence district, nothing has been developed better than the modern asphalt pavement. It has been adopted on a majority of the streets in New York City. While many miles of inferior pavement of this type have been laid there, all of a period long past, they are as rapidly as possible being superseded with a modern type of construction on a concrete foundation, which promises much greater durability and ease of maintenance. The relative lesser amount of this surface in European cities is very largely due to the fact that we have had no good pavements on any but a few streets in each city up to very recently; whereas it has been the practice abroad for many years to construct good macadam surfaces in all residence districts. At the present time foreign cities are following our custom of laying this class of pavement on new light traffic streets, and in the large real estate developments around Berlin asphalt was adopted almost exclusively. The cities of Paris and Vienna last year made contracts for extensive repaving with asphalt, which was being substituted in Vienna for the old stone surfacing of the Boulevard; while Paris was tearing out many miles of stone block, inferior wood and macadam and relaying with asphalt. This work will undoubtedly be resumed in all these cities when it is again possible to devote attention to rebuilding.

Much more difficult in our country than the writing of specifications appears to be the securing of the desired result. A strong difference seems to exist between our practice and that of Europe in this matter. A careful comparison of foreign methods with ours brings out very strongly the greater care given by us to the prepa-

ration of exact specifications and the greater attention given by them to the producing of the result for which the specifications were written. It would seem as if some of our city engineers thought that the whole aim of their office had been attained when they had succeeded down to the last period in describing chemical and physical qualities of the materials to be used and the exact details to be followed; just as in our country we have too great a tendency to regard our record file and office systems as ultimate ends. The specifications used in such important cities as London, Birmingham, Liverpool, Hamburg and Berlin, and even in Paris where the most attention is given to detail of any city in Europe, seem noticeably weak in contrast to ours and to leave much to the honesty of the contractor. Whereas when it comes to the execution of the work the attitudes are reversed, and the European engineer and contractor seem to work in harmony with but one end in view, namely, the construction of the particular piece of work called for at the price agreed upon. A recognition of the difference of national traits furnishes no indication of how to change them, except as pointing out the direction in which almost all of our cities can obtain better work, that is, in the line of closer inspection of materials and workmanship of construction. It is a problem that is worthy the attention of many men who may have a tendency to regard anything but the scientific end of engineering construction as beneath their dignity.

Even when his pavement is constructed in the best manner the engineer in charge of city highways has merely solved his preliminary problems and has remaining his real task of keeping the pavement down. Part of the solution of this question can be taken up after construction in the installation of an adequate system of keeping track of street defects and openings and the prevention of the latter by proper restriction on the issuance of permits and careful inspection of the work done under them; but the real method of controlling street openings so as to reduce them to a minimum is in the hands of the city planners and it is beyond the power of those charged with street maintenance to do more than regulate it to the best of their ability. It is in this line that the observer finds European superiority most apparent. He sees nothing in engineering construction problems as a whole done better abroad than here but does find European municipal governments taking charge of and regulating in an orderly manner first, the planning and laying out of street developments and then the installation in them, beneath the surface, of the necessary public utilities, so that when once constructed the street shall be as nearly permanent as possible. The chaotic condition of subsurface pipes beneath the streets in our great cities is notorious, but it is no argument except to those afraid to undertake any change to say that it must continue because it has always been that way. We must arrange in our new streets in entirety and in our older ones by changing whenever the opportunity occurs to provide beneath the sidewalks or footways for the installa-

tion of all necessary house service lines, leaving the space beneath the roadway for main sewers, passenger subways and the large water and gas mains, thus eliminating as much as possible our most frequent cause of street opening for the giving of additional house service to private parties.

In the office of the City Engineer of the city of Hamburg is a set of drawings showing standard sections officially adopted for all city streets of whatever width and on each is specified in its vertical and horizontal relation to curb and house line the position of each class of pipe and even the position of the trees and their longitudinal spacing are standardized. For the improvement of the worst of our old streets we can follow the example of London, which has constructed some six miles of pipe galleries in which are placed electric light and telephone wires and minor gas service lines. The installation of pipe galleries to any great extent is an almost prohibitive expense, but it is not impossible as a solution of the trouble in our densest streets, and by adopting the principle of utilizing the space beneath our footways, instead of presenting them for a nominal consideration to private parties, a great ultimate saving will be caused. Subsidewalk vaults need not be entirely eliminated for this, as a depth of only a few feet below the surface is required for the necessary pipes and wires; but our cities should not give up important space in their crowded streets merely to provide illumination by means of sidewalk dead-lights to the basement of adjacent buildings. It must be recognized, however, that the idea that only in this country do we make frequent street openings is a mistake.

No system can provide for all the necessities arising from future development, and only in a city which has ceased to grow would it be possible to conceal all evidences of construction. A careful observation shows in every great city of Europe conditions paralleling many of those complained of in our streets, particularly in regard to the extent to which the building constructor is allowed to use the public thoroughfare for his private purposes, even on such famous thoroughfares as Unter den Linden, the Champs Elysees and Regent Street; while it is of particular interest to call attention to the comparison in the number of street openings between the borough of Manhattan of New York City having a total mileage of streets of 455 and the city of Westminster, London, with 100 miles of street. The average annual number of permits granted for street openings in the former is about 25,000; in the latter, 20,000; and though it is undoubtedly true that the superficial extent of our excavations in New York is by far the greater, yet the figures indicate that even in the greatest city of the world there has been no final solution of the greatest problem which confronts the administrator in charge of the construction and maintenance of city streets.

In concluding these necessarily cursory notes, the fact must be emphasized that the choice of the most satisfactory type of wearing surface, is largely a local one. New York lays wood pavements only

on level streets, Berlin only on grades. Other forms of block pavement than those largely used in New York, are giving satisfaction elsewhere. Time does not permit of reference to the many successful brick streets and those of various types of bituminous concrete, within the limits of neighboring cities. The question of paving construction in and adjacent to the tracks of street railways, is a problem in itself.

One point above all must be kept in mind—careful work for a short time, will lay a good pavement; it can only be kept in its place in condition for use by constant vigilance. A thorough organization for the purpose of inspecting and reporting defects and for the execution of immediate repairs, is the prime requisite of a good highway bureau.

THE CHAIRMAN: The discussion of this paper will be opened by Captain J. W. Barnett, City Engineer of Athens, Georgia.

CAPTAIN BARNETT: *Mr. Chairman and Gentlemen of the American Highway Association:* I have been deeply interested in the paper which has just been read. I wish very much that I could have had access to this admirable document before the hour of discussion arrived, because there are many points of interest to engineers of this country contained therein and I would liked to have studied them more carefully before undertaking to lead in this discussion, but, in as much as I have not had the opportunity, I wish to make a few statements as to some of the most salient points. I feel that the author's wide experience and travel fit him admirably for the handling of this most difficult subject. I notice that he makes the statement that only 10 per cent of the total area of the pavements laid in European cities have a permanent foundation, a concrete foundation. That is a most startling statement to me. I have never gone into that phase of the question abroad very carefully, have been laboring under the impression that the European pavements were of the very best class possible, that they took every precaution to overcome any possible failure in the foundations. I can readily see from this statement how many grievous errors have been made in this country in the construction of pavements. I understand now how so many engineers have been led to believe that a permanent form of pavement can be constructed without the use of a concrete foundation, using this as a precedent. They evidently have not taken into consideration the different conditions existing abroad and in this country. The European cities are very old, their principal highways have been in existence for centuries and doubtless very little, if any, material changes have been made in the grades. Therefore they have a natural foundation which, is, comparatively speaking, very good, upon which to lay a pavement. In this country the reverse is true. The rapid growth of our cities has necessitated frequent and constant changes in the grades, leaving a foundation upon which we must lay concrete or some other form of material

sufficient to support the permanent surface. I note also, in this admirable paper that reference is made to the different proportions used throughout Europe and this country in the mix of concrete used in the foundations. A great many engineers have been misled by the proportions given in many specifications. They seem to think that a 1–3–6 or a 1–2–4 mix in New York City is suited for Atlanta regardless of the character of the ingredients entering into the mix. The profession is too prone to adopt the specifications of other cities. I think the proportioning of concrete is one of the most important things to decide. We should take the materials in hand, consider the percentage of voids and proportion the mix as may be required to form a dense concrete. I simply touch on this particular point because I feel that there are a great many errors being made in this, resulting in too weak a foundation to sustain the traffic. The increase in volume and weight of traffic is rapid. The advent of the heavy motor truck and other conveyances, carrying thousands of tons, necessitate a better class of construction than that used heretofore. The gentleman refers also to the matter of selection of the pavement. That is a matter that is not given proper thought. Political influences are too frequently brought to bear in making this decision. We do not consider as fully as we should traffic conditions and the interests of the adjacent property holders to the thoroughfares to be paved. We are inclined to adopt some form of pavement because some other city does.

The author refers to the matter of maintenance. To my mind that is the most serious problem confronting us today. The people of the South do not regard this question as they should. The average person feels that the pavement once laid is good for all time. If you see fit to make minor repairs in two or three years the taxpayer declares the venture a failure. Regardless of this feeling, repairs should be made promptly and systematically. It is an easy matter, with the experience of other cities, to select specifications that are effective; it is an easy matter to properly lay a pavement, but the question that gives most concern is that of maintenance. The Public Utility corporations are a great menace to our pavements—I mean the street railways, the telephone and electric light companies. Sewer, gas and water mains which have to be gone into frequently are the most disturbing elements. I do not know the practice in cities generally as to the matter of maintenance, but it seems to me that when an excavation is made in the streets that the repairs should be left entirely with the city officials, the engineering department. The engineer's office should be notified when the surface is to be replaced and a trained force sent for the purpose of restoring the pavements. That I think is the key note of success in the restoration of pavements where openings are necessary and have to be frequently made. From my own experience I know it is a matter of impossibility to get contractors and others who are paid so much per square yard to make a satisfactory job. Gentlemen, I thank you very much.

MR. KING: Suppose you have a macadam street or road or a gravel road, and you want to surface it with asphaltic concrete or something; would you tear that up in order to get the concrete base and build a concrete base? Did you ever try using the macadam and gravel road as a substitute for the concrete base?

CAPTAIN BARNETT: No, I have not. I am very glad you brought up that point. I will tell you what I am doing at Athens, Ga. We have quite a lot of macadam roads that have been down for from ten to fifteen years without any repairs of a consequence being made on them. Now they are full of holes and unsuited for the automobile traffic, so I have undertaken to substitute for the macadam a concrete pavement. I am ripping up the macadam and using the stone as a matrix, and I think we are getting excellent results.

MR. KING: We have a two mile stretch of road from the city limits to the country club in Memphis and it had been a splendid gravel road and we let a contractor surface that with two inches of asphaltic concrete, machine mixed method. The gravel of course was brought up to the proper contour, the holes filled and swept well. That has been down a year and a half; 300 to 500 automobiles traveling over it every day or so and it is holding out splendidly. I have a five years' maintenance guarantee. It cost $10,500 a mile to fix that and put it down and we are using that gravel as a concrete base and I am watching it with a good deal of interest.

A MEMBER: What width?

MR. KING: It is 20 feet wide and wearing admirably; not a nickel of repairs so far.

CAPTAIN BARNETT: Under those conditions I am inclined to believe that a concrete road could have been built for the same amount of money and you would have a road that would be there long after your scheme will have been forgotten. We are building concrete roads for $1.10 a square yard under the conditions named and along these streets we have street car lines, which increases the difficulty.

MR. KING: What will you surface with?

CAPTAIN BARNETT: Tarvia, a paint coat about a quarter of an inch in thickness.

DR. PRATT: At the outset, most of us in the South had an idea that this subject was applicable principally to larger cities, but there is one phase of the question of maintenance that is applicable to all our small towns and villages that I want to emphasize in a few words,

and that is I think we should draw a lesson from what has been done in larger cities, as for instance, borough of Manhattan, New York, where they had something like 400 and odd miles of streets and something like 25,000 excavations a year; we should take a lesson from them, that in our small towns and villages throughout the South when we permit those streets to be dug up, that we should be just as emphatic that the one responsible for digging up that street either puts up a bond or a sufficient amount of money as a guarantee that the road surveys of that town or village will be put back in as good shape as it was before he began to do the digging. We think that because perhaps our village streets are surfaced, or sand clay graveled, or paved with a block pavement or concrete, it is not necessary to make those stipulations with those who are digging up our streets, but many of you who ride in automobiles have felt the result of the indiscriminate digging up and making excavations in streets in our small towns, by coming across what is apparently a "thank-you-ma'm" across a street. There is no excuse whatever for those being allowed in any of our small villages or towns of the South or North or East or West, and we should be just as careful to have our streets put back in good shape as they are in the larger cities or towns. And then just one other thought in that same connection which also has bearing on maintenance, and that is where we have our water pipes and sewers put down through these streets, let us see if we cannot pass an ordinance that connections shall be made with abutting property before the surfacing is done on that road and not have the experience I had not so very long ago; within 30 days after a road had been surfaced, there were six applications to cut that surface to connect abutting properties with the water main, when the order had already been given three months before that they should connect with the water main. Of course that is the fault of those in charge of the town itself, but to my mind we should take these lessons from the larger cities and put them into practice in our smaller towns and villages.

MR. WILLIAMS (of West Virginia): Following up what Dr. Pratt says, Huntington, West Virginia, solved that problem in a measure; they have an ordinance requiring all places in the street where openings have been made in any street surface for the purpose of making pipe connections, to be concreted from the pipes up to where the base of the bricks, or whatever surface goes in, is put in. That makes it so that the man, the next time he goes to get in there, will have to tear up the entire concrete, and the effect of that causes most every fellow that has connections to be made, to get busy and get it made at the right time because the property owner or whoever makes the connection has to pay this extra amount and then afterwards he has to stand the expense of taking it out in case of any repair to be made; not only that, but the filling in of the concrete in that way prevents the thank-you-mam that the doctor refers to.

MR. WATKINS: In some of our cities in Washington, we have an ordinance that provides for putting water mains and sewer connections in at the time the water mains and the sewer pipes are laid to the property line for each sub-division of property, and there is a tax against that property and it has to be paid by the owner to provide for this and it obviates cutting up the streets.

MR. SHIRLEY: We charge $1 a square yard for earth cut out, $3 a square yard for macadam, $6 a square yard for asphalt, brick or concrete; this is charged against whoever makes the opening. We have had quite a great deal of trouble over those charges. The department makes the repairs after the cut has been made. The trouble comes in with us that public service corporations charge the individual the cost of repairing the pavement, in some places it will run up as high as $100. I have had delegations in my office of as high as 200 people asking to be relieved of that work. I have put down a pavement and after it has been down six months have had 39 applications made in a block to cut it for a new set of houses. That represented 39 families. I have had those 39 families to contend with and it is a problem. I would like to see some standard plan worked out. With us it is one of the most disagreeable parts of the work we have to handle. If you make these charges, public pressure is brought to bear to be relieved of them. We passed a rule that any pavement laid should not be opened for 4 years, and they even went to the legislature to make a new law about it. A man who owns a plot of land, we will notify him that a pavement is going to be laid at a certain time and that no opening will be made for 4 years. He will sell that land maybe two weeks after the road is laid; the land is developed, those lots are sold to different individuals, the individual makes the application for these water mains and if any of you here know what it means to have a home without water, gas, electric lights, etc., and have the ladies and gentlemen of the family behind you trying to get them in, you know you are up against a tough proposition.

MR. LEECH (of Steubenville, Ohio): We have an ordinance that authorizes the engineering department to make as many taps as they deem necessary before a pavement is laid down, and charge it to abutting properties. The Gas Company, likewise, make their taps for the property before a pavement is put down, under the directions of the engineering department; then we charge a permit of $25 for tearing up a pavement within five years after it is put down. We have had very little occasion to tear up any streets in the last seven or eight years outside of what comes from a break or leak in the line. If a piece of ground is not sub-divided we imagine the sub-division and maybe we get in one or two too many but we put it in anyhow and charge it to the abutting property and it gives us very little trouble.

MR. DURHAM: There were one or two points brought out in the discussion which I thought it would be of interest to make a passing comment upon; one on the question of foundations. We do not in New York or anywhere else recognize the foundation as anything but some hard and durable non-compressive material on which the wearing surface is laid. Concrete is put there with the object of producing such a surface. If you have already a material just as hard and durable as concrete, there is no need of concrete. We have recognized that in one of our streets in New York where I was criticized by an inspector of the Finance Department who discovered that we were laying our concrete only 3 inches thick and I was called on for an explanation of that fact. It was supposed that a contractor was being allowed to scant his contract. In reply I pointed out that we were re-laying an old metallic road on a Telford base. There were 9 inches of good Telford in there and to pull out that good Telford to refill it with earth and 3 inches of concrete on top of that was ridiculous, so our concrete foundation is merely one means of getting a hard, incompressible foundation. The other points on the subject of street openings brought out quite an interesting discussion and I want to state that the problem in New York or London or in smaller cities is essentially the same. We require all applicants for permits to open a street pavement, to make a cash deposit of double the value of restoring that pavement. We inspect the work and then we, either with our city labor or a contractor, make the restoration and hold the balance of the money due for six months. In case there is no settlement the permittee gets the return of that balance. In case of any settlement, the pavement is resurfaced at his expense. In the case of a large public service corporation, it is permitted to put up a bond, but a cash deposit of $5000 is also required, because it is so handy in case of emergency. The superintendent of an office building in which one of our great daily papers is published made an application to open one of our cross streets two weeks after the pavement was finished. I asked him why that was necessary and he said, "It is due to the action of the Water Department in making a change in the valve some distance away" whereby they had the possibility of only one connection to their building and in case of emergency the newspaper would be unable to go on and the wheels of the nation would stop. The permit was refused. The application was renewed with additional pressure. I saw that applicant and told him that if he would bring me a letter from the responsible editor of that newspaper, the application would be granted. It has never been renewed and the pavement has not been opened.

BITUMINOUS MACADAM BY THE COLD MIXING METHOD

By Irving W. Patterson

Chief Engineer of the Rhode Island State Board of Public Roads

The Rhode Island State board of public roads has, beginning with the year 1906, constructed a large amount of bituminous macadam by the cold mixing method, this type of construction being generally considered typical of Rhode Island State highway work. Reports of certain sections of our bituminous macadam construction have been rendered at gatherings of this kind in past years, but as a rule these reports were made so soon after the date of construction that definite conclusions regarding the success of the work could not be drawn. It is the writer's intention in this paper to give a résumé of this work since the date of its inauguration in 1906 and to draw certain conclusions regarding the points of construction and the adaptability of the cold mixing method, based upon his experience with work of this type in Rhode Island.

The first attempt made by the State highway authorities of Rhode Island to avoid the deficiencies characteristic of plain waterbound macadam construction by the incorporation of a bituminous binder was upon the so-called Post Road which practically parallels the south shore of the State. This road is subjected to the heavy through automobile traffic between the famous shore resorts of Rhode Island and the large cities to the south and west. A traffic census upon this road taken during 1913 showed an average summer travel of approximately 600 vehicles daily, consisting very largely of motor vehicles. The construction work upon this section was carried out during midsummer of 1906.

In 1906 there was little reliable information concerning bituminous macadam available, so the exact methods of carrying out the work necessarily had to be decided upon more or less arbitrarily. After considerable discussion by the engineers in charge of the work, it was decided to use a crude tar as a binder and to incorporate this material with the road metal by the cold mixing method. The mineral aggregate employed in the mix was crushed stone of sizes which were retained upon a one-half inch screen and which passed an inch and one-half screen.

The stone employed was native field and wall stone, which is a rather coarse grained, somewhat kaolinized granite.

The metalled surface was constructed 14 feet wide with a crown of three-quarters of 1 inch per foot.

All rolling was accomplished by means of a ten-ton, three-wheel steam roller.

The construction in brief was as follows. Crushed stone which was retained on an inch and one-half screen and which passed through a 3 inch screen was first spread over the well rolled sub-grade

to a depth of 4 inches after compression. This course was not filled with sand or stone screenings but was well rolled. Crude tar was very lightly sprinkled over this first course of stone. Crushed stone of the sizes stated previously was then mixed with crude tar in the proportion of 15 gallons of tar per cubic yard of stone. Mixing was carried out upon a portable wooden mixing platform placed as closely as convenient to the point where the mixture was being spread. The mixture of stone and tar was spread over the first course of crushed stone to a depth of 2 inches after compression. The mixture was well rolled, after which a covering of stone screenings was applied.

No foundations and no sub-drainage were deemed necessary upon this work because of the stable character of the gravelly sub-soil encountered.

The results secured upon this first experimental section of bituminous macadam were remarkably successful. No repairs have been required to date. The surface today is perfectly intact and presents a perfect mosaic appearance, due to the top surfaces of the stones in the mixture being all in evidence.

In 1907 a much longer section of bituminous macadam was constructed about one mile east of the first experimental section. The method of construction was almost identical with the construction employed the previous year. The results secured upon the section built in 1907 were inferior to the results secured in 1906. The surface began to ravel slightly in 1912, and during that year a seal-coat of refined tar was applied. Today the surface is somewhat irregular and a few breaks are in evidence, although the riding qualities of the road are very fair. We attribute the relatively inferior results secured from our work in 1907 largely to a less stable sub-soil.

It will be noticed from the foregoing brief description of the method of construction that no seal-coat was applied at the time of construction. Subsequent experiments have proved the advisability of seal-coating. We attribute the marked success of this early work in spite of the absence of a seal-coat largely to the character of the travel. The horse-drawn traffic over both of the above sections is very light, and we believe that the blows of horses' shoes upon the exposed surfaces of the soft stones would be destructive if horse-drawn traffic occurred in any considerable amount.

In 1908 bituminous macadam by the cold mixing method was taken up to much greater extent. Various experiments both in materials and methods were carried out, and today we are able to see that these experiments were largely negative in results produced. We tried many materials and combinations of materials which did not give satisfaction, and no work noticeably superior to the work of 1906 and 1907 was done. Results approximating those secured in 1906 and 1907 were secured, however, upon sections constructed in the same manner as were the bituminous roads built those years. Perhaps the greatest failures in the work during 1908 were upon sections where tar products and asphalt products heated in separate kettles were used in combination as a binder for the top course of

crushed stone. Where this combination of binders was employed, ravelling started the following year and increased in extent very rapidly as time went on. In 1913 a heavy seal-coat of asphalt was applied to several of the roads bound with a combination of tar and asphalt and the results secured from this treatment appear highly satisfactory.

In 1909 some very interesting experiments were carried out and these experiments produced some very positive results. It is true that there was work done in 1909 according to methods tried out in 1908 and since proved unsatisfactory, but at the date of the construction of the 1909 work it was not to be ascertained for a certainty what of the 1908 work was satisfactory and what was not, due to the short time the work had been done.

Upon the Nayatt Point road in the town of Barrington the most interesting and valuable experiments of the year were carried out. The section of this road selected for the experiments offered excellent opportunities for experimental work because of the remarkable uniformity and excellent stability of the sub-soil encountered. We are reasonably certain that foundation troubles have not been responsible for any of the defects which have developed in any of the experimental sections. These experiments have been completed long enough now so that we are enabled to draw certain definite conclusions from them. The results are not of any particular interest as far as the comparison of methods of construction is concerned but they are of great interest in the comparison of bituminous materials. We give below a report of these experiments, together with descriptions of the repairs necessitated upon each section and the appearance presented by each section October, 1914.

REPORT OF BARRINGTON 1909 EXPERIMENTAL WORK

All of the experiments were carried out between August 31, 1909, and October 22, 1909.

The soil encountered throughout is a sandy loam which allows of free percolation of water and is never subject to heaving due to frost action.

The traffic is composed largely of motor vehicles, although in early spring and late fall considerable heavy horse-drawn traffic is found. The traffic over the road is not excessive—a fair daily average of the number of vehicles passing over the road between May 1 and October 1, being very close to 350. During the remainder of the year, the traffic is less.

The metalled surface was constructed 14 feet wide and crowned three-quarters of an inch to the foot.

The stone employed upon all of the experimental sections with the exception of Section No. 1 was native field and wall stone which was in large part a fine grained, hard granite. Upon Section No. 1 Connecticut Trap Rock was employed.

The type of construction employed upon all of the sections was bituminous macadam by the cold mixing method.

The total depth of road metal was six inches after rolling. No foundations were deemed necessary because of the stable character of the sub-soil, and no sub-drains were constructed. The crushed stone was laid in two courses. The first course consisted of crushed stone which passed through a three-inch screen and was retained on an inch and one-half screen, laid to a depth of 4 inches after compression. Neither filler nor bituminous material was applied to this course. The second course of stone, into which bituminous material was incorporated, was laid to a depth of 2 inches after compression. The surface covering consisted of clean one-half inch stone screenings. The first course of stone was well rolled previous to the laying of the second course of stone.

Except upon two sections (Sections 7 and 8) mixing was done by hand upon a wooden mixing platform composed of two separate parts, each 8 feet square. This platform was laid on top of the first course of stone immediately ahead of the point where the mixture was being laid. Six men were employed in mixing the stone with the bituminous binder and shovelling the mixture onto the road. Mixing was carried out until all stones were completely covered with bituminous material. The crushed stone was not heated previous to mixing. In addition to the six men who did the mixing there were two other men in the gang who assisted in handling the bituminous part of the work—a raker who graded the mixture after it was shovelled onto the road and a man who took care of the kettles in which the bituminous material was heated. In the construction of Sections 7 and 8 a mixing machine known as the American Tar Company Mixer was employed. This machine was not a mechanical mixer, since it was in effect merely a special heated platform upon which mixing was accomplished by pulling by hand the crushed stone through a reservoir of heated bituminous material. The same number of men were employed in mixing with this contrivance as were employed in the mixing upon a mixing platform.

All of the experimental sections were seal-coated at the time of construction. The seal-coat was applied with ordinary house brooms.

All rolling in connection with the work was accomplished with a fifteen-ton, three-wheel roller.

The analyses of the bituminous materials were all made in the testing laboratory of the Rhode Island State Board of Public Roads.

EXPERIMENT NO. 1

(*Crude tar and asphalt in mix with asphalt seal-coat—trap rock*)

Construction. Upon our first experiment we employed a mixture composed of 50 per cent crude tar and 50 per cent hard asphalt in the mix. The tar and the asphalt were heated in separate kettles and applied separately to the stone upon the mixing platform—the tar always being spread over the stone first and the asphalt last.

A seal-coat of the same asphalt that was used in the mix was applied over the mixture.

The amount of binder employed for the mix was 18 gallons per cubic yard of stone.

The amount of binder employed for the seal-coat was $\frac{3}{4}$ gallon per square yard of surface.

The stone employed was Connecticut Trap Rock throughout. The first course of crushed stone consisted of the commercial $2\frac{1}{4}$ inch stone and the second course, with which the binder was incorporated, with commercial $1\frac{1}{4}$ inch stone which was claimed to be of sizes retained upon a $\frac{1}{2}$ inch screen and which passed a $1\frac{1}{2}$ inch screen.

Cost. The cost of this section was $0.827 per square yard exclusive of grading.

ANALYSIS OF CRUDE TAR

Specific gravity	1.256	
Water soluble material (organic)	0.700	per cent
Water soluble material (inorganic)	0.000	per cent
Free carbon	30.200	per cent
Ash	0.000	per cent
Fixed carbon	38.000	per cent
Melting point of normal material	too soft	
Evaporation 5 hours at 170°C.	18.600	per cent
Melting point of residue	70.000	degrees
Penetration of residue at 40°C.	0.750	
Penetration of residue at 25°C.	19.600	
Distillation	20.680	per cent
Up to 105°C.	1.600	per cent
105°C. to 170°C.	2.640	per cent
170°C. to 225°C.	5.740	per cent
225°C. to 270°C.	6.820	per cent
270°C. to 300°C.	3.880	per cent

ANALYSIS OF ASPHALT

Specific gravity	0.994	
Water soluble material (organic)	0.190	per cent
Water soluble material (inorganic)	0.000	per cent
Free carbon	0.270	per cent
Ash	0.290	per cent
Solubility in cold carbon tetra-chloride	98.730	per cent
Fixed carbon	12.600	per cent
Paraffine	0.410	per cent
Melting point of normal material	95.000	degrees
Evaporation 5 hours at 170°C.	0.550	per cent
Melting point of residue	103.000	degrees
Penetration of residue at 4°C.	20.000	
Penetration of residue at 25°C.	36.000	
Evaporation 5 hours at 205°C.	1.060	per cent
Melting point of residue	117.000	degrees
Penetration of residue at 4°C.	14.000	
Penetration of residue at 25°C.	30.000	
Solubility in 88° B. naphtha	68.300	per cent
Character of solution (oily or sticky)	sticky	
Viscosity 100°C.		
New York Testing Laboratory viscosimeter	379.000	seconds
Viscosity 25°C.		
Penetrometer	30.000	

Results. This section was very nearly a failure. Hair lines developed inside of one month after completion and by the following spring ravelling had become quite extensive. Patching has been necessary each year since construction. What remained of the original surface by October, 1914, appeared rough and hair-lined and numerous breaks were in evidence.

We feel that the character of the stone employed in the mix was one reason for failure. The percentage of the smaller sizes of stone as compared with the percentage found in native stone was small in the commercial trap rock, so the rolled mixture consequently was far from compact. The combination of tar and asphalt in the mix is also to our minds a reason for failure. Such a combination has never given us first-class results, although with some grades of stone the results have been fair.

EXPERIMENT NO. 2

(Crude tar and asphalt in mix with asphalt seal-coat—native stone)

Construction. The second experiment was practically a duplication of Experiment No. 1 with the exception that native stone was employed in place of Connecticut Trap Rock. The binders employed were purported by the manufacturers to be identical with the binders used in Experiment No. 1, and the analyses of the materials showed that such was the case. The analyses were so nearly identical with the analyses given of the materials employed upon Experiment No. 1 that they are not here given.

There was a slight variation in the quantity of binder employed for the mix, 15 gallons per cubic yard of stone being used instead of 18 gallons. The same amount of binder (¾ gallon per square yard) was used for the seal-coat.

Cost. The cost of this work was $0.788 per square yard exclusive of grading.

Results. The results secured upon Experiment No. 2 have proven fairly satisfactory. There have been a few breaks in the surface which required repair. These breaks have occurred with increasing frequency since construction. The cost of maintenance during a period of five years was approximately $0.025 per square yard.

Upon examination in October, 1914, the surface presented a smooth asphalt finish except in a very few spots where the seal-coat had worn off and allowed the surfaces of the stones to become visible. A sample of the road taken up showed, however, that there was no appreciable life left in the binder. The material in the seal-coat appeared to be in good condition.

The superior success of this section as compared with Experiment No. 1 we attribute to the superior grading of the sizes of the native stone with the resulting stronger mechanical bond.

EXPERIMENT NO. 3

Refined coal tar in both mix and seal-coat

Construction. Upon our third experiment a refined coal tar of the characteristics shown below was employed. The quantities employed were 16.5 gallons per cubic yard for the mix and $\frac{3}{8}$ gallon per square yard for the seal-coat. Native stone was employed.

Cost. The cost of this work was $0.838 per square yard exclusive of grading.

ANALYSIS OF REFINED TAR

Specific gravity	1.222
Water soluble material (organic)	0.400 per cent
Water soluble material (inorganic)	0.410 per cent
Free carbon	24.700 per cent
Ash	0.100 per cent
Fixed carbon	29.390 per cent
Melting point of normal material	too soft
Evaporation 5 hours at 170°C	15.000 per cent
Melting point of residue	62.000 degrees
Penetration of residue at 4°C	2.000
Penetration of residue at 25°C	15.000
Distillation	19.690 per cent
Up to 105°C	0.000 per cent
105°C to 170°C	0.380 per cent
170°C. to 225°C	7.820 per cent
225°C. to 270°C	8.280 per cent
270°C. to 300°C	3.210 per cent

Results. The results to date have been very satisfactory, although a complete renewal of the seal-coat is called for. No repairs to the metalled surface were carried out until the fall of 1914, although the necessity for repair was evident for some time previous. The seal-coat began to disappear noticeably about one year after construction. Two years after construction a true mosaic surface was presented by the exposed surfaces of the crushed stone. The surface gradually became rougher, due apparently to the decomposition of the binder in the surface voids. Ravelling was not in evidence until the summer of 1914. The need for renewal of the seal-coat was felt in 1913, but since the section was experimental, we wished to see exactly how long it would be before disintegration set in.

Examination during October, 1914 (previous to any repairs being made), showed a rough mosaic surface with occasional evidence of ravelling. Abrasion of the stone by traffic was very evident, the surface being covered with a very light coating of particles of stone which apparently had been broken off from the stones composing the road surface.

EXPERIMENT NO. 4

Asphalt in both mix and seal-coat

The characteristics of the asphalt employed in this experiment may be obtained from the analysis given below. The quantities of binder employed were 21 gallons per cubic yard of stone for the mix and $\frac{3}{8}$ gallon per square yard for the seal-coat.

Cost. The cost of this section was $0.898 per square yard exclusive of grading.

ANALYSIS OF ASPHALT

Specific gravity	0.965	
Water soluble material (organic)	0.320	per cent
Water soluble material (inorganic)	0.000	per cent
Free carbon	0.340	per cent
Ash	0.030	per cent
Solubility in cold carbon tetra-chloride	99.620	per cent
Fixed carbon	7.990	per cent
Paraffine	0.160	per cent
Evaporation 5 hours at 170°C	16.600	per cent
Melting point of residue	65.000	degrees
Penetration of residue at 4°C	46.000	
Penetration of residue at 25°C	105.000	
Evaporation 5 hours at 205°C	19.100	per cent
Melting point of residue	116.000	degrees
Penetration of residue at 4°C	29.000	
Penetration of residue at 25°C	58.000	

Results. The results obtained upon this section are to date superior to the results secured upon any other section. No repairs have been necessitated.

Examination during October, 1914, showed a perfectly intact, smooth asphalt finish.

EXPERIMENT NO. 5

Refined tar containing 20 per cent of asphalt in both mix and seal-coat

Construction. The material used in this section was a refined tar mixed with 20 per cent of asphalt at the manufacturer's plant. The quantities of material employed were 24 gallons per cubic yard of stone for the mix and $\frac{5}{8}$ gallon for the seal-coat.

Cost. This section cost $0.924 per square yard exclusive of grading.

ANALYSIS OF BITUMINOUS BINDER

Specific gravity	1.176	
Water soluble material (organic)	0.490	per cent
Water soluble material (inorganic)	0.110	per cent
Free carbon	18.600	per cent
Ash	0.050	per cent
Solubility in cold carbon tetra-chloride	74.000	per cent
Fixed carbon	27.400	per cent
Evaporation 5 hours at 170°C	10.500	per cent
Melting point of residue	70.000	degrees
Penetration of residue at 4°C	2.000	
Penetration of residue at 25°C	12.000	
Evaporation 5 hours at 205°C	17.500	per cent
Melting point of residue	80.000	degrees
Penetration of residue at 4°C	$\frac{1}{4}$	degrees
Penetration of residue at 25°C	$2\frac{1}{4}$	
Viscosity 25°C.		
Penetrometer	too soft	

Results. The results obtained upon this section are very fair. The surface became perfectly mosaic inside of two years from the date of construction, due to the disappearance of the seal-coat. No repairs have been given this section, but the need for a renewal of the seal-coat has been appreciated for two years.

Inspection during October showed a rough mosaic surface, perfectly intact as far as ravelling is concerned, and slightly darker in color than the surface of Section No. 3.

EXPERIMENT NO. 6

Refined tar containing 10 per cent of asphalt in both mix and seal-coat

Construction. The binder employed in this experiment was manufactured by the same concern which furnished the material for Experiment No. 5. The only difference claimed for the material was the different percentage of asphalt. The quantities of binder employed were 24 gallons per cubic yard of stone for the mix and $\frac{5}{8}$ gallon per square yard of surface for the seal-coat.

Cost. The cost of this section was $0.917 per square yard exclusive of grading.

ANALYSIS OF BITUMINOUS BINDER

Specific gravity	1.211	
Water soluble material (organic)	0.580	per cent
Water soluble material (inorganic)	0.000	per cent
Free carbon	22.500	per cent
Ash	0.090	per cent
Solubility in cold carbon tetra-chloride	69.500	
Fixed carbon	26.200	per cent
Evaporation 5 hours at 170°C	13.500	per cent
Melting point of residue	67.000	degrees
Penetration at 4°C	1.000	
Penetration of residue at 25°C	10.000	
Evaporation 5 hours at 205°C	18.000	per cent
Melting point of residue	85.000	
Penetration of residue at 4°C	$\frac{1}{2}$	
Penetration of residue at 25°C	$1\frac{1}{2}$	
Distillation	18.690	per cent
Up to 105°C	0.290	per cent
105°C. to 170°C	1.000	per cent
170°C. to 225°C	3.290	per cent
225°C. to 270°C	9.430	per cent
270°C. to 300°C	4.680	per cent

Results. The results obtained upon Section No. 6, were not noticeably different from the results secured upon Section No. 5. No repairs have been carried out upon this section to date.

Observation during October, 1914, could disclose no differences in appearance or condition from Section No. 5, except perhaps a slightly lighter color.

EXPERIMENT NO. 7

Refined tar in both mix and seal-coat

Construction. Mixing in this experiment was carried out with an American Tar Company mixing machine. The amounts of material used were 24 gallons per cubic yard of stone for the mix and $\frac{5}{8}$ gallon per square yard for the seal-coat.

Cost. The cost of this section was $0.910 per square yard exclusive of grading.

ANALYSIS OF REFINED TAR

Specific gravity	1.244	
Water soluble material (organic)	0.240	per cent
Water soluble material (inorganic)	0.430	per cent
Free carbon	24.500	per cent
Ash	0.010	per cent
Fixed carbon	30.700	per cent
Melting point of normal material	too soft	
Evaporation 5 hours at 170°C	11.900	per cent
Melting point of residue	63.000	degrees
Penetration of residue at 4°C	3.000	
Penetration of residue at 25°C	15.000	
Distillation	20.660	per cent
Up to 105°C	0.000	per cent
105°C. to 170°C	0.320	per cent
170°C. to 225°C	4.760	per cent
225°C. to 270°C	10.870	per cent
270°C. to 300°C	4.710	per cent

Results. The results secured in this work are not appreciably different from the results described in the report of Experiments No. 3, where also a refined tar was employed. Ravelling has not progressed to the extent that it has upon Section No. 3, but examination showed evidences of ravelling.

EXPERIMENT NO. 8

Refined water-gas tar

Construction. Mixing upon this section was accomplished by means of an American Tar Company mixing machine. The quantities of binder used were 24 gallons per cubic yard of stone for the mix and ⅜ gallon per square yard of surface for the seal-coat.

Cost. The cost of this work was $0.932 per square yard exclusive of grading.

ANALYSIS OF REFINED WATER-GAS TAR

Specific gravity	1.167	
Water soluble material (organic)	0.250	per cent
Water soluble material (inorganic)	0.130	per cent
Free carbon	2.420	per cent
Ash	0.110	per cent
Fixed carbon	22.100	per cent
Evaporation 5 hours at 170°C	15.500	per cent
Melting point of residue	74.000	degrees
Penetration of residue at 4°C	0.500	
Penetration of residue at 25°C	3 000	
Distillation	16.830	
Up to 105°C	0.000	per cent
105°C. to 170°C	0.000	per cent
170°C. to 225°C	0.000	per cent
225°C. to 270°C	10.390	per cent
270°C. to 300°C	6.440	per cent
Viscosity 25°C.		
Penetrometer	too soft	

Results. The results secured upon this section have been very satisfactory. One patch was necessitated about one year after com-

pletion, but no further repairs have been needed. The seal-coat has worn off, but decomposition of the binder has not extended down in the surface voids appreciably.

Examination during October, 1914, showed a smooth mosaic surface very dark in color as compared with the surfaces of the other sections which appear mosaic. The surface was perfectly intact. The need for a renewal of the seal-coat is beginning to be in evidence.

EXPERIMENT NO. 9

Crude tar in mix, asphalt seal-coat

Construction. Mixing upon this section was carried out by hand upon mixing platforms. The quantities of binder employed were 18 gallons per cubic yard of stone in the mix and ¾ gallon per square yard in the seal-coat.

Cost. The cost of this section was $0.816 per square yard exclusive of grading.

ANALYSIS OF TAR

Specific gravity	1.256	
Water soluble material (organic)	0.700	per cent
Water soluble material (inorganic)	0.000	per cent
Free carbon	30.200	per cent
Ash	0.000	per cent
Fixed carbon	38.050	per cent
Melting point of normal material	too soft	
Evaporation 5 hours at 170°C	18.600	per cent
Melting point of residue	70.000	degrees
Penetration of residue at 4°C	0.750	
Penetration of residue at 25°C	19.600	
Distillation	20.680	per cent
Up to 105°C	1.600	per cent
105°C. to 170°C	2.640	per cent
170°C. to 225°C	5.740	per cent
225°C. to 270°C	6.820	per cent
270°C. to 300°C	3.880	per cent

ANALYSIS OF ASPHALT

Specific gravity	0.994	
Water soluble material (organic)	0.190	per cent
Water soluble material (inorganic)	0.000	per cent
Free carbon	0.270	per cent
Ash	0.290	per cent
Solubility in cold carbon tetra-chloride	98.730	per cent
Fixed carbon	12.600	per cent
Paraffine	0.410	per cent
Melting point of normal material	95.000	degrees
Evaporation 5 hours at 170°C	0.550	per cent
Melting point of residue	103.000	degrees
Penetration of residue at 4°C	20.000	
Penetration of residue at 25°C	36.000	
Evaporation 5 hours at 205°C	1.060	per cent
Melting point of residue	117.000	degrees
Penetration of residue at 4°C	14.000	
Penetration of residue at 25°C	30.000	
Solubility in 88° B. naphtha	68.300	per cent
Character of solution (oily or sticky)	sticky	

Viscosity 100°C.
New York Testing Laboratory viscosimeter..... 379.00 seconds
Viscosity 25°C.
Penetrometer..... 30.000

Results. No ravelling has ever taken place upon this section. The only repairs necessitated to date have consisted merely in touching up spots where the seal-coat had disappeared. The expense of maintenance to date has been less than $0.005 per square yard.

A smooth asphalt surface was presented by this section upon examination during October, 1914. There was no evidence of ravelling to be seen, but in a very few small spots the disappearance of the seal-coat allowed the top surfaces of the stones to be seen.

CONCLUSIONS DRAWN FROM ABOVE EXPERIMENTS

These experiments at Barrington seem to prove that certain forms of the cold mixing method are very satisfactory upon roads subjected largely to motor vehicle traffic. Only two of the sections have necessitated repairs of any account during the five years they have been laid. Both of the sections requiring repair were laid with the same combination of binders, and the much greater extent of repairs necessitated upon the section constructed of trap rock is of interest in consideration of mineral aggregates.

It was shown conclusively that a seal-coat of asphalt is much more permanent than a seal-coat of refined tar, although both the crude tar and the refined tars gave excellent results as far as their binding of the mineral aggregate is concerned.

The effectiveness of refined water-gas tar is also proven. The section built of this product is superior at present to either section built of refined coal-tar.

BITUMINOUS MACADAM SUBSEQUENT TO 1909

In 1910 the typical construction employed was a mixture of crude tar and crushed stone, seal-coated with a heavy asphaltic product. It will be noticed that this construction is identical with the construction employed in Experiment No. 9 at Barrington the previous year.[1] The facility with which the crude tar could be handled and the good results secured with this material previously accounted for its extended use in 1910. The results secured with this type of construction in 1910 were very successful. With one exception these roads have required only the lightest of repairs to date, the exception noted being located upon the main street of a large village and constructed of commercial 2½ inch and 1¼ inch trap rock. This road had disintegrated somewhat by the spring of 1911, and from that time on the disintegration rapidly became greater in extent. By the spring of 1913 the condition of the surface was serious. Several breaks of 10 square yards or more in area appeared, and small breaks were very numerous. It was decided to patch the breaks

with a mixture of three-quarter inch trap rock and refined tar and to apply over the entire surface a seal-coat of asphalt covered with clean one-half inch trap rock screenings. Asphalt of approximately 15 mm. penetration was applied at the rate of one-half gal on per square yard of surface and covered while hot with screenings, which were rolled with a 6-ton tandem roller as soon as possible. This work was done in June, 1913. The results of this treatment have proved very satisfactory, no further ravelling having taken place to date.

Mixing in 1910 was accomplished by the hand mixing method upon wooden platforms.

The crude tar which was used to the greatest extent in our work during 1910 was the product of the Providence gas plant. Since 1910, vertical retorts have been installed at this plant and the crude tar at present produced is not suitable for use by the mixing method without previous refining. The Providence gas house tar used in 1910 was remarkable for its uniform good quality, and we doubt if we could duplicate the results secured that year with any crude tar at present available in sufficient quantity for our needs.

In 1911 no appropriation for road work was made by the General Assembly and consequently no bituminous macadam was constructed.

In 1912 an attempt was made to duplicate in effect the excellent results secured in 1906 by the use of crude tar by employing a comparatively light refined tar. It was the express intention to apply to the roads built with this refined tar a seal-coat of asphalt as soon as need for such treatment was evidenced, thereby securing eventually the same type of road which was so eminently satisfactory in 1910.

Mechanical mixing was introduced into our work for the first time in 1912. The type of mixer employed upon practically all of the work was a cube mixer of approximately one-half cubic yard capacity fitted with a heating device. The stone was not heated previous to mixing, the heating device being employed merely for the purpose of keeping the inside of the mixer warm so that it would not become clogged. The heat was developed by a flame generated by the combustion of crude oil sprayed under pressure, and this flame entered the mixer. It is the writer's opinion that this direct flame was responsible for burning the bituminous material in several cases.

The stone employed in the mix upon the work in 1912 was both local 1½ inch stone and commercial 1¼ inch trap rock. The results secured with the local stone averaged superior to the results with trap rock.

The results secured upon our work in 1912 were variable. In 1913 it was deemed necessaary to seal-coat with asphalt approximately 42 per cent of the total area of the roads constructed in 1912. During 1914 approximately 6 per cent of the total area was seal-coated with asphalt. The roads which have not been seal-coated

are in very good condition at present, but we anticipate the necessity for applying a seal-coat to all of them during the next two construction seasons. The seal-coating of the work done in 1912 has been very effective to date, but it is as yet too early to draw conclusions regarding the results of the 1912 work after seal-coating as compared with the results secured in 1910 where the seal-coat was applied at the time of construction.

During 1913 the amount of bituminous macadam constructed by the cold mixing method was small as compared with the amount constructed in 1912. Two methods were employed. The type of construction employed in 1910 was taken up to some extent with a refined tar in place of a crude tar—a seal-coat of asphalt being applied at the time of construction in exactly the same manner. An asphalt of characteristics similar to the asphalt employed upon Experiment No. 4 at Barrington in 1909 was used to some extent in both mix and seal-coat. The work by both methods has proved perfectly satisfactory to date, although the construction is so recent that definite conclusions cannot be drawn. Trap rock was employed satisfactorily in the mix for the first time during 1913. The commercial three-quarter inch size of trap rock was employed in place of the commercial 1¼ inch size which was previously used, and this product has given excellent satisfaction to date.

It has been proved in our work that the utmost care in constructing bituminous macadam by the cold mixing method is necessary. The crushed stone must be perfectly dry at the time of mixing and all stones must be perfectly covered with bitumen in order that good results may be secured. The manner of carrying out the rolling is also important in its effect upon the results obtained. It is, of course, necessary to secure by rolling as compact a mass as possible, but we have found that considerable care must be exercised in regulating the time and amount of rolling. If the weather is cool at the time of construction, we frequently postpone the heavy rolling until mid-day, when the maximum warmth is experienced, although the initial rolling is done as soon after the mixture is laid as possible.

The character and sizes of the crushed stone employed are also of great importance. We have secured the best results, as far as stone is concerned with our native rock, which is rather variable in character. As a rule our native rock is softer than trap rock and breaks with a much more irregular fracture than trap rock. There is more or less breaking of the native stone by rolling, and this appears to be beneficial rather than otherwise in that a denser pavement is secured. We feel that if trap rock is employed, smaller sizes are necessary than are necessary with a softer stone, unless there is a certainty of securing a perfect crusher-run from 1½ inch to one-quarter inch or less.

We have experimented with heating the aggregate previous to mixing, but these experiments seem to show that inferior results are secured as compared with the results obtained with the same

materials where the aggregate is unheated. The aggregate in bituminous macadam contains at best a large percentage of voids, and in the heated aggregate there was noted a tendency upon the part of the binder to run off from the stones, leaving only a very thin coating upon each stone. In several cases, for instance, 18 gallons of binder per cubic yard of stone were necessary to cover all stones in our unheated mineral aggregate, but when the aggregate was heated, 12 gallons would cover all stones and there would be considerable bitumen which would run through the mineral aggregate and be lost. The tendency for the bitumen to cover a heated aggregate very lightly seems to be due to the fact that the heat retained by the stones does not allow the binder to become hard for a considerable time, with the result that it continues to run for nome time. We recognize that it is necessary to heat the aggregate is a dense mixture such as a bituminous concrete pavement affords, but in bituminous macadam work by the mixing method we prefer a cold aggregate or an aggregate heated but slightly.

The weather conditions influence the results obtained in bituminous macadam by the mixing method considerably. We have noticed that roads built late in the fall just before freezing sets in are not apt to be as satisfactory as those built in mid-summer, even though the temperature at the time of construction is not low. It seems to be a decided advantage to roads built by this method of construction to have a comparatively long period of warm weather immediately after construction in order that the surface may become freed from the top covering of stone screenings and well smoothed out before snow and ice appear. In Rhode Island we consider the season most favorable to this type of construction to be between the middle of May and the middle of October.

Upon the whole, the cold mixing method of constructing bituminous macadam as practiced in Rhode Island appears to be an economical pavement for motor vehicle traffic. It does not appear to the writer as suitable for heavy horse-drawn traffic or for a heavy mixed traffic. The traffic upon several of the trunk lines in Rhode Island consists of motor vehicle traffic to the extent of over 90 per cent of the total amount of traffic, and it is upon these roads that we expect in the future to confine our bituminous macadam roads built by the cold mixing method. Through large villages where the percentage of horse-drawn traffic is large, we expect to take up a stronger method of construction.

THE CHAIRMAN: The next paper on the program has been taken from the afternoon session and transferred to the morning session. It is a paper on "Convict Labor," by Mr. George P. Coleman, State Highway Commissioner of Virginia.

CONVICT LABOR

By George P. Coleman
State Highway Commissioner of Virginia

Prior to 1906 the convicts of this State were let out to contract, first, in the construction of railways and other public works, and then under one contract for the making of shoes. This was done in the Penitentiary enclosure, in buildings constructed by the contractor. In the revision of our constitution on 1903, section 185, provides that the Legislature may make provision for the use of her State convicts and jail men in the construction of State and county roads. With this end in view, the Legislature of 1906 passed the Withers-Lassiter law, placing certain of her convicts on the roads. This law has been amended by each succeeding Legislature until its provisions are about as follows:

A county or district of a county desiring to use convicts in the construction of its public highways, must make application, through the county road authorities, to the Highway Commissioner, for a force of convicts. This application must designate the road or roads to be improved, their approximate length and location and the amount of money on hand to carry on the construction. The Highway Commissioner will, as soon as possible after the receipt of this application, send an engineer to the county to make the necessary surveys for changes in location from which plans, profiles, estimates of cost and specifications are prepared. These estimates, plans, etc., are then furnished the county road authorities, and if agreed to by them, the Highway Commissioner then makes requisition on the Superintendent of the Penitentiary for a force of men. The county road authorities, in this second application, agree, on the part of the county, that the work shall be done under the direct supervision of the Highway Commissioner; they also agree that the work shall be done either by contract or by force account; if the former, the work is then advertised by the Highway Commissioner and the bids are opened at the county court house and the work is let to the lowest responsible bidder, subject to the approval of the commissioner. In this contract the contractor agrees to take a certain percentage of the whole amount in convict labor and agrees to use not less than a given number of men during the life of the contract. These convicts are furnished to the contractor at 10 cents per hour per man, the total for each month being deducted from the monthly payments of the contractor, the county thereby securing the benefit of this deduction. In the first contract made, it was agreed to furnish the contractor all labor necessary for his work, but it was found that under this plan the labor was used uneconomically and wastefully. The rules now require that a contractor shall not use less than 30 per cent, nor to exceed 40 per cent, of the total contract in convict labor. We are, however, working

away from this plan, that is, using convicts on contract work, finding that under the second plan, that of force account, we get better results both for the county and for the convict.

Should we decide to do the work by force account, the county road authorities agree first to have the work done under an engineer or superintendent appointed by the Highway Commissioner, who has complete charge of the whole work. They further agree to furnish all necessary teams, tools, machinery, materials, etc., necessary to economically and expeditiously carry on the work. They also agree to pay the superintendent and all necessary free labor, such as foremen, blacksmiths, etc., for it is not always possible to get this class of labor from the convict body. We also require the county to provide such medical attendance as the prisoners may require. The law requires that the prisoners shall be furnished by the Superintendent of the Penitentiary on the requisition of the Highway Commissioner. It further states that the Superintendent shall furnish a sergeant and the necessary guards to properly care for the men, stipulating, however, that the Highway Commissioners shall agree to the appointment of both sergeants and guards, and that if at any time the Highway Commissioner should see fit, the Superintendent must remove any sergeant or guard unsatisfactory to him. It further stipulates that the Highway Commissioner and the Superintendent shall agree on the necessary rules and regulations for working the convicts.

The Virginia convict road force is composed of all male convicts, who are considered safe by the Superintendent of the Penitentiary, and all male jail men over sixteen years of age, and this force, when placed on a county road or in a county quarry, is guarded, fed, clothed and transported at the expense of the State; this about equally divides the cost of the road work between the county and the State.

A suitable camp site is selected with a view to proper drainage and a plentiful supply of good water; also that the men will not have to walk at any time exceeding two miles to or from their work. This is particularly important, since walking in gangs of ten to twenty is necessarily slow. The camps for the men are divided into a sleeping house, wide enough for a row of cots down each side, and an 8 foot passage way down the center, built to hold from fifty to eighty men. The men are supplied with all necessary bedding, etc., and in winter the building is heated with stoves. Next to this is the dining camp and at one end of this is the store room, kitchen and guards' dining room. Facing these, and a little to the side, is a camp with two rooms, one for the sergeant and the other for the guards. All of these buildings have corrugated metal roofs, and canvas sides, and the sleeping quarters have wooden floors and are so constructed that they can be readily taken down and moved to new locations. In addition to the sergeant, there are from three to five guards, depending on the size of the camp. The pay of the

sergeant at first is $50 per month and his board, which amount is gradually increased to $75 per month and board. This amount may be further increased by placing the sergeant in charge of the road construction. The pay of the guards begins at $25 per month and board, and may be increased to $35 and board. The guards are also required to supervise and direct the work of the men when called on to do so by the Superintendent, but with the class of men available at the price, this has not been found practical. The salaries of the sergeants and guards constitute the heaviest cost of maintaining the State convict road force, and up to the present time we have not been able to devise any plan which will enable us to materially reduce this cost.

As a general thing, from three to five prisoners are kept in the camp to do the cooking, cleaning, washing, etc. The remaining men are divided into gangs of from four to twenty men, the worst class of the prisoners being placed under guard and worked in the quarries or gravel pits or on the grade. The trusties are sent off in small gangs to shape the road, spread stone, build culverts and headwalls and are used as blacksmiths, firemen, rollermen, drivers and water boys. The best men in the quarries and on the grade are trained as drill runners and enginemen and if their behavior warrants it, are made into trusties and sent off on work not requiring a guard.

The Legislature of 1906 appropriated $25,000 for the maintenance of the convict road force for eighteen months, and the last Legislature appropriated $145,000, together with the jail fees, which will give us about $180,000 for the maintenance of the force for 1914. Since the organization of the Department, we have used convicts in thirty-seven counties and at the present time we are maintaining camps in thirty-one counties, representing about eleven hundred convicts and five hundred jail men working on the roads of the State. It has cost the State during the past year to clothe, feed, guard and otherwise provide for this labor, approximately fifty-one cents per ten hour working day. It is quite impossible to compare convict labor with free labor unless you are working them side by side and under exactly the same conditions. I have heard a great deal said about the inefficiency of prison labor as compared with the same class of free labor, the usual argument being that you cannot expect to get the same results from men working under compulsion and without compensation and hope of advancement. From eight years' experience, we are of the opinion that prison labor properly handled, that is, with intelligence and humanity, is just as satisfactory and efficient as any other class of common labor with the additional advantage of being regular and under perfect control. You are in a position to train each man for his particular work and to derive an immediate benefit from that training.

Now of course we get all classes of men sent to the roads, some whose physical condition is such that they are incapable of doing

hard work; these are made into water boys, yard men, drivers, etc.—in other words, they are given such work as they are capable of doing. We have found that working prison labor on the roads is not without its drawbacks. In many sections of the State the work is light and it is not always advisable to string your men out as needed. Nor is it possible or economical with the funds in hand to employ a sufficient number of guards. Our experience has led us to believe that the most economical results can be obtained from prison labor working under guard, when that labor is concentrated and when it is worked near their headquarters. One thing is certain—the use of prison labor on the roads in Virginia has quickened the demand for better roads and given an impetus to the movement that nothing else has ever done. So much, then, for the benefit accruing to the counties and the State from the use of this labor in improving her highways.

The State realizes that its first duty is to improve both morally and physically this class of its citizens, and to send these back into the world better able to cope with its temptations, and we feel that road work is a move in the right direction. In dealing with this phase of the question, you must not lose sight of the fact that about 75 per cent of the prison population of this State is negro, and that your problem is thus made doubly difficult. The prisoners in our road force are allowed a reduction in their term of imprisonment of four days each month for good behavior, and when they prove that they can be trusted and are competent, they are given more skilled employment. It is the endeavor of each sergeant to have as many trusties on his work as possible; these men are put on special work without guards, and are allowed special privileges. Should they, however, break the rules or regulations, they are, as a punishment, placed back under the guard. The men are well clothed and fed and generally well cared for—they live and work out of doors and while each man is required to do a full day's work, they are never driven. There are a number of instances where the men on the completion of their sentence have been employed by contractors on the same work at good wages, and in many instances employed by farmers who live near the road work, and in this way they are kept away from their former haunts. One of the direct advantages to the convicts working in these camps, must be the training they receive in cleanliness and sanitary precautions of every kind. Consider that most of them are from the slums of cities, that few of them have ever received training of any sort in the proper care of themselves physically, and you cannot fail to realize how much they must gain from the practical lessons they receive in assisting in the locating and management of the camps. The careful choice of a site, the precautions taken in guarding the spring or well from which the water supply is obtained, the disposal of all sewage, the cleanliness of the kitchen and the utensils used and the isolation of any member of the camp suspected of any infectious disease—

these are all points on which the State officers have expended much time and many thousands of dollars to bring forcibly home to their uneducated citizens, and in no way could a class most needing such education receive it more thoroughly or clearly than in a well ordered road camp. Another important advantage derived from working prison labor on public highways, is that it brings the average citizen in touch with the situation, thus giving him an entirely different point of view; he is able to see for himself that very few of the convicts are dangerous and that many of them, if given a chance, will make good citizens. Changes are undoubtedly needed in the management of our prison labor, but it is difficult to lay down any one rule and say that if you follow this you will get the best results for the men, and therefore for the State as a whole.

The Superintendent of the Penitentiary proposes to make an effort to get the Legislature of Virginia to provide an appropriation with which to pay each prisoner who obeys the rules five cents for each day's work. This will amount to something like $15 per annum for each prisoner and it is proposed to pay that amount to the prisoner on the completion of his sentence. This will permit the discharged prisoner to have a small amount of money to start with on his release, and it is to be hoped that some such law will be enacted at the next session of the Legislature, for according to our present law, the prisoners are discharged without help of any kind other than their transportation, except such as is voluntarily given by the sergeant or men in charge of the road work.

I would like, however, to suggest for your consideration, the following plan which could be followed to advantage in this State, that is, grouping your prison population into four classes:

First. Long term and dangerous men.

Second. Short term men.

Third. Trusties.

Fourth. Paroled men.

The first class shall include all murderers and all prisoners whose records are known to be bad and all prisoners sentenced for third offences.

These men are to be dressed in stripes and worked in stockades and under guard in State stone quarries. This material is to be supplied to the counties of the State to be used in the construction of their roads. It would, of course, be necessary to locate these quarries advantageously and with good transportation facilities. It would also be necessary to secure low transportation rates from the railroad companies to insure an economical distribution of the material.

The second class, to be composed of short term men, men convicted for the first time, and such men from class I as by experience you would find that you could trust even a little, these men to be dressed in blue or brown and distributed throughout the State to the various county road camps and to be worked under guard in the grading and construction of the county roads.

The third class, to be composed of trusties, or, if you please, Honor men, and to be taken from class II, these men to wear an ordinary khaki suit and to be worked without guards and used as rollermen, enginemen, cooks, yardmen in the State and county camps, in small gangs to shape road and spread stone, in building concrete bridges, culverts and headwalls, and in every way made to feel that they are in places of trust and above all that they are being trusted. We have considered the matter of working prisoners in large forces, without guards, as is being done in some of the Western States, but have not yet been able to devise a plan which appeared feasible with the class of prisoners we have in our camps, though we may be able to do so later.

The fourth class, paroled men. These men to be taken from class III and paroled for good behavior at some period of their sentence, I would suggest at the expiration of half of their time. These men to wear ordinary clothing and to be assigned to the maintenance department of the State or county, to be used as patrolmen on maintenance of the roads or on such other maintenance work as may seem best. These men to be furnished with proper quarters and paid a monthly wage, and where practical, given a house and small plot of ground and urged to have their families with them, these men to be a regular part of the State or county's free labor road system, the only difference being that they shall be required to report monthly to some general head.

THE CHAIRMAN: The discussion on this paper was to have been opened by Mr. J. E. Maloney, State Highway Engineer of Colorado. Mr. Maloney is unable to be present but has sent his paper in, which will be read.

CONVICT LABOR IN COLORADO

JAMES E. MALONEY

Secretary-Engineer State Highway Commission

In discussing the very interesting paper of Mr. Coleman, to my mind, the question resolves into a general proposition for improving the condition of the prisoners, and at the same time performing some useful work for the State.

In considering the question of convict labor, it is well to keep in mind these two propositions; one, the regeneration of the convict himself and his future welfare, and the other, the financial benefit to the State. If it is possible to accomplish both of these points, then indeed, is the practice of working convicts on the roads, a benefit to both the State and the prisoners.

The selection of the trusties and the placing of the men at the various tasks are functions which belong to the warden of the Penitentiary, who is in direct touch with the men, and through his

study of human nature is enabled to pick out the men best suited for the different positions.

In Colorado, in addition to the various tasks for the upkeep of the Institution, such as the laundry, hostlers, gardeners, etc., the State has a farm of several hundred acres, on which, during the summer season, many of the prisoners are employed.

In addition to this, starting from the year 1899, the employment of the prisoners upon the State highways has been gradually extended, until at this time our present warden, T. J. Tynan, has seven road camps at work in various parts of the State, employing an average of 250 prisoners in total at these seven camps.

The first work in 1899 was done in the upper Arkansas River Valley, in the neighborhood of Buena Vista, under the bill introduced in the Legislature by Senator T. J. Ehrhart. In this year considerable work was also done in Fremont County by the convicts. Later, in 1905, a bill was introduced by Senator Lewis, and another one in 1907 by Senator Barella, the latter bill providing for a convict built road from the New Mexico State line at the south, to the Wyoming State line on the north. The Lewis bill, is the one under which our convicts are now being successfully worked on the roads under the present administration. Copy of this bill follows:

S. B. No. 224, by Senator Lewis.

AN ACT

Providing for the working of the convicts in Colorado State Penitentiary upon the public roads and highways within any county and upon the streets and alleys within the cities and incorporated towns located in the State of Colorado.

Be it Enacted by the General Assembly of the State of Colorado. SECTION 1. Upon the written request of a majority of the board of county commissioners of any county in the State of Colorado, the Warden of the Colorado State Penitentiary, situated at Canon City, in Fremont County, shall detail such convicts as in his judgment shall deem proper, not exceeding the number specified in said written request, to work upon such public roads and highways of such county or streets and alleys of any city or incorporated town within such county as shall be designated in said written request of said county commissioners; Provided, That such county shall pay all additional expense of guarding said convicts while working upon said public roads and highways within such county, and shall furnish all tools and materials necessary in the performance of said work; And, Provided, That when said work is done within the limits of any city or incorporated town within such county, or city or incorporated town where said work shall be done shall likewise pay all additional expenses of guarding such convicts while performing said work and shall furnish all necessary material used in said work.

SECTION 2. Said convicts when employed under the provisions of Section 1 of this act shall not be used for the purpose of building any bridge or structure of like character which requires the employment of skilled labor.

SECTION 3. The Board of Penitentiary Commissioners are hereby empowered to adopt a special rule applicable solely to convicts employed on the public work herein authorized and contemplated, whereby convicts so employed shall be granted additional good time allowance, conditioned upon their good behavior and cheerful compliance with all rules that may be made by said board or said superintendent for the management and control of convicts so employed.

SECTION 4. All acts, or parts of acts, in conflict herewith are hereby repealed.

SECTION 5. In the opinion of the General Assembly, an emergency exists; therefore, this act shall take effect and be in force from and after its passage.

Approved April 11, 1905.

Work was started on the main State road from Trinidad to the New Mexico line, and finished in 1907 by Warden Cleghorn. The famous "Sky Line Drive" at Canon City was also completed under Mr. Cleghorn's administration, and the development of the system of working convicts without gun guards and solely upon honor was started by Mr. Cleghorn. Our present warden, T. J. Tynan, took charge of the work in 1909, and has extended and developed the system, until at this time it is one of the very successful adjuncts of the State system of road work.

It has been stated by one of the superintendents of the convict camps, that "The use of this labor not only cheapens the construction to the State, but takes the men out into God's sunshine, where the steady employment and wholesome life of the road camps are accomplishing wonders in arousing energy and ambition, and some of these men have never before realized that they were capable of doing an honest day's work. Prison labor has some disadvantages. The men from all walks of life are thrown together, and in most cases they have to be taught the use of the road builder's tools, but as the work progresses, the majority of them learn to take an interest and pride in their work."

The convict camps are made up of all nationalities and races, many Mexicans and negroes being among them. The desire to take advantage of the opportunities offered by the work upon the roads, is shown by all the prisoners, and the great majority of them soon exhibit a very keen interest in the work. All classes of crimes have been represented by the convicts worked upon the roads. It has not been found desirable or necessary to divide the convicts into classes, segregated according to the character of the crime, and if there is any division to be made between the prisoners, it should be based upon the individual characteristics of the prisoners, rather than upon the crime for which he has been convicted.

The State does not pay the convicts any salary or per diem for their labor, but they receive credits, which enable the prisoner to cut his minimum sentence in half. Any attempt to escape or violate the established rules results in the loss of all credits, and instead of cutting his time practically in half, he has to serve his full maximum sentence. There are no armed guards used in any of these camps, the men being placed entirely upon their honor, and I believe this is one reason for the very satisfactory results obtained by the present warden. If you use armed guards to restrain the prisoners from any attempt to escape, then why exact any promises from the men, but if you accept a promise from them, to the effect that they will not attempt to escape, then they should be trusted. Other-

wise, the moral effect of their promise is absolutely lost. Under our present system, the attempts to escape have not been over 1 per cent, and when 99 per cent of the men keep their word, it stamps the system as successful.

The typical organization of the convict road camp is about as follows:

The camp is under the charge of a superintendent, who is assisted by one, two or three foremen, as the size of the camp may require. These men are all the salaried officials there are connected with the camp. An average of 25 to 50 prisoners may be detailed to any one camp. In all of the camps of the State the quarters are provided by the county and State Road Fund, as distinguished from the Penitentiary Fund. This equipment consists of wall tents of extra heavy canvas, with flies, and in case of winter quarters the walls of the tents being boarded and papered, and stoves provided. The men sleep in separate bunks in tents provided for that purpose, about 4 to 8 to a tent. There is a superintendent's tent, necessary shelter for the stock, etc., and in fact, the equipment is the same as would be used by a contractor prosecuting the same piece of work, except that the men are better provided with shelter, clothes and food.

The sanitary conditions are looked after very carefully; the cleanliness of the camp, and the physical well-being of the men are especially looked after by those in charge of the work. Sanitary precautions and close inspection of the health of the men are points which are conducive to better work.

The stock necessary for the hauling of supplies to the camp, or for working upon the roads is also supplied by the County and State Road Fund. An outfit for camp purposes may run from $1000 to $2000, not including the cost of the stock. Clothes for the prisoners are supplied by the Penitentiary. A prisoner's transportation is furnished by the counties, except where a prisoner is returned to the Penitentiary for any infraction of the rules, or attempt to escape, in which case the Penitentiary stands the expense. No armed guards of any kind are used at any of Colorado's convict camps. As a general rule, the night watchman is one of the prisoners.

The pay of the superintendent runs from $100 to $125 per month. For assistant foremen, the salary runs from $75 to $90 per month.

In the last two years the prisoners have constructed a total of about one hundred miles of road.

Under the law, the control of the convicts is entirely in the hands of the warden and penitentiary officials, the supervisors and foremen being appointed by them, and this is, I believe, the proper method, as the prisoner is in the custody of the warden, and the warden is responsible for him during the term for which he is sentenced.

The State Highway Commission has assisted the counties and prison officials in the establishment and employment of the road

camps by apportioning funds to the counties for the construction of certain pieces of the connecting State Highways, and enabling the counties to equip and maintain the camps. The position of the Highway Commission in connection with the convict road construction is purely advisory; the matter of the engineering assistance and suggestions being made through the county commissioners, who are the active executives in dealing with the warden of the Penitentiary.

In regard to the actual costs of maintenance for these camps, I submit the following statements, which include four camps, as follows:

No. 1. Two camps for the season of 1913 and 1914; No. 3. One camp from June, 1913 to October, 1914; No. 4. One camp during 1913 and 1914—total 24 months.

In the first two camps during 1913 from October 1912 to July 1, 1913, or ten months, the total cost was $6284.74 (equipment not included). The total number of days in that period of time was 308. The total number of days worked was 248. The average cost of food per man per day was 31½ cents; the average cost per man per day was 61½ cents; this includes all salaries, repairs, stock feed, etc; and the average cost per man per day actually worked on the roads was 77 cents. The average number of men in camp for this time was 40, about eight of these being used about the camp. The average number of head of stock, 8; average cost per mile of road built, $2513.89; they having completed 2½ miles of mountain side hill work, 16 feet in width.

In this second camp for the season of 1914, or from August 1, 1913, to September 1, 1914, being 13 months, inclusive, the total number of days was 396. The total number of days worked was 296½. The average number of men, 33; the average number of head of stock, 6; the average cost per man per day for food was 37.6 cents, and the average total cost per man per day was 89.15 cents; the average cost per mile, $3163.60, a total length of 3.67 miles having been finished during the season at a total cost of $11,613.96. The average cost per man per day actually at work on road, $1.50. This includes a drilling outfit, which cost $2000.

The work consisted of mountain sidehill and some very heavy rock for about 1¼ miles; the balance was earth and loose rock, moderately heavy timber clearing; the roadway averaged 16 feet in width.

In the third camp, the work started June 10, 1913 and extended to October 1, 1914 inclusive, making a total of 15 months. During this time some 6½ miles has been completed, at a total cost of $29,164.38. This includes about $1800 for a portable drilling plant, and gives an average cost of $4487 per mile. Of this work about 4 miles is in heavy rock work, and about 1½ miles in heavy earth and gravel, and 1 mile of light earth work.

In the next camp the convicts have been at work for the past four seasons, and their work is mostly in open prairie country, and

has consisted of a great deal of work with blade graders and traction engine haul for the graders, and also horse haulage for the dirt, and the grading and scraping machines. The average number of men employed has been 25; the average number of horses employed has been 16; the total miles of road improved has been 94; the total number of bridges and culverts built by the convicts was 60; and the total miles surfaced, 61. The average cost of this work to the county for the past four seasons has been approximately $1150 per mile, including bridges and culverts.

In estimating the comparative value of the convict labor as against the free labor, it would be essential to have the yardage moved and to have the classification of material. As in the case where the counties do their work by day labor, the engineer does not always cross-section the work, simply placing the center and grade stakes for the use of the superintendent, and an occasional cross-section stake, giving the width and general outline.

This, however, is not sufficient to fully calculate the yardage on any of these pieces of work. A comparative idea may be had by the actual cost of labor per day per man actually at work on the road. This runs from 77 cents to $1.50 per day; and having this figure prepare the relative efficiency of the labor as between the prisoner and the ordinary road laborer. I believe this work of the prisoners will show an average saving of about 25 per cent for the conditions under which they have been worked in this State. In some cases a much larger saving than this is shown, and in other cases the saving is smaller. In starting an outfit for this kind of labor many drawbacks will be encountered at the beginning, especially in the selection of men to superintend the camp, and this is an important position, but once started they can be kept running smoothly.

In conclusion, I can say that our experience with this method of employment for the prisoners committed to the Penitentiary or Reformatory, has been entirely satisfactory.

THE CHAIRMAN: Mr. E. R. Morgan, State Road Engineer of Utah, will continue the discussion on this paper.

MR. MORGAN: You, no doubt, have observed that in Mr. Coleman's opinion the use of convict labor has two main purposes, namely, the utilization of their energy from an economic point of view, and the uplift of the prisoner from a humanitarian point of view. The fundamental conception of the problem will likely be accepted by all. Using it as a basis, the conclusion is justified that the system, which has been in use in Virginia and is yet, at least to some extent, is not an efficient one, as it must be apparent that a contractor is chiefly concerned with the economic phase of the question. It is probably true that whatever consideration the question of benefit to the prisoner receives from the contractor is incidental,

and contingent upon the pecuniary benefit he is to get from the use of the convict's energy.

Convict labor must be entirely in the control of the State or the county concerned, and used exclusively for the benefit of such community, and the convicts. The intention of the officials of the State of Virginia to obtain a monetary consideration for the convicts is commendable for, no doubt, even a small sum of money at the expiration of their terms would tend to prevent their committing further crimes during the period in which they should be endeavoring to place themselves on a self-sustaining basis. The amount of money set aside from the funds of a community, county or other political sub-division on account of services performed by convicts, should be materially increased; part of it to be retained by the State for expenses of prosecution, keep, etc.; part to be paid to the dependents rendered so by the crimes committed by the respective prisoners; and the remainder to be paid to the prisoners at the expiration of their sentences.

As mentioned by Mr. Coleman, there is no doubt that convict labor can be more advantageously prosecuted if the convicts are properly classified. The classification, however, in my opinion, should be made with reference to the character of the men; if working in separate camps and with reference to the kind of service they are capable of giving, if laboring in the same camp.

Utah is yet struggling with the A B C's of convict labor. Nevertheless, I believe that to note what we have done in this matter will be helpful in the discussion of the question.

The Legislature of Utah in 1909 enacted a law, which provided that prisoners in the State prison may be required to work on the roads under regulations made by the State Board of Corrections. Boards of County Commissioners wishing the services of the convicts were required to make application for them to operate them under the State Board of Corrections without financial assistance from the State for their subsistance while at work. Convict labor on the roads in Utah was hitherto untried, and the results were unknown. The inducements by the law for the use of convicts on the roads were thought to be small, and therefore, the law failed. In 1911, the Legislature enacted a law giving the State Road Commission, and the State Board of Corrections control of convict labor on State roads. The supervision of the work was given to the State Road Commission. Power was granted to the State Board of Pardons to give privileges to convicts who perform service upon roads, public buildings or grounds, especially a reduction of sentence, conditioned upon their good behavior and efficient service while so employed. Twenty thousand dollars was appropriated for the use of the warden in the purchase of camp equipment and supplies, paying for the service of extra guards, and the transportation of men and camp equipment. There was also appropriated for the use of the State Road Commission the sum of $40,000 for the purchase of construction equipment.

In May and June of 1911, the State Road Commission purchased equipment amounting to about $15,000, and work was commenced in July. The work undertaken was a macadam road in Box Elder County. Between 40 and 50 convicts were employed on the road. They were directed by a construction superintendent who was assisted by 4 guards. The road was first graded, cobble stones were gathered from the adjacent hillsides, crushed and delivered on to the road by teams, spread, rolled and sprinkled, after which the drains were made. From this statement, it will be seen that a variety of service was rendered, some of which was skilled. There were built 2.5 miles of road at a cost of about $2000 per mile. For camp purposes in this work, the use of a 5-acre tract of land was obtained. The kitchen, dining and sleeping tents were enclosed in a stockade made by building a barbed wire fence, 10 feet high, around a 125-foot square. The wire was spaced 4 inches. The prisoners were guarded day and night. Each line of fence forming the enclosure was illuminated at night by carbide lights. During the operations of this camp, two men escaped from the enclosure but were recaptured.

In December, 1911, about 20 trusties were taken to Washington County and worked until about the middle of the following April, during which time, they were not guarded closely and no man tried to escape. This is mentioned in order that the progress in convict management may be noted.

In August, 1913, the State Road Commission more than doubled its construction equipment. The convict camp was enlarged to about 70 men, and the construction of the concrete road undertaken.

The population at the Utah State Prison varies between 275 and 300 men. About 40 of these are working outside the prison walls, on the grounds and farm. In order to obtain 70 other men who could be trusted and who were capable of performing the desired service, considerable care and judgment was required. A number of long term men including murderers, burglars, and holdups were selected. At the camp, the dining, sleeping and kitchen tents were located within a square surrounded by a single smooth wire which was illuminated at night by carbide lights at diagonal corners. For the safety of the prisoners, a head guard was made responsible. He was assisted at night by 4 guards. The prisoners were guarded and directed in their work during the day by 4 other guards, who in turn were directed by the head guard and the construction superintendent. The double headed organization is notable and objectionable from the standpoint of expense, but it is nevertheless difficult to obtain guards with construction ability or construction superintendents who will assume the responsibility of convict camp discipline.

Material and supplies were hauled from Salt Lake City to the road by convicts a distance of 6 or 7 miles without an accompanying guard, so it will be seen that considerable freedom was allowed the prisoners.

About 4 miles of concrete road 16 feet wide and 7 inches thick were constructed. The road which has been built has cost about $8000 per mile. Prison labor has lessened the cost per mile from $1500 to $2000.

The State Board of Pardons authorized the warden to allow a commutation of sentence of 10 days for every 30 days the prisoner spends at the road camp regardless of whether he is sick or whether the weather conditions will permit of the work being prosecuted, conditioned, however, upon the faithful observance of camp rules. During the time they have been employed, 8 have escaped from camp, 5 of which have been recaptured, a very enviable record from a purely prison management point of view.

At camp, after working hours, on Sunday and holidays, they are permitted to play ball, pitch horseshoes, or engage in other recreative exercises. About 20 good magazines are furnished regularly for the use of the camp. Daily papers are allowed, but not furnished.

The camp at present is provided with bathing facilities so that every man may bathe daily if he wishes and must do so at regular intervals.

The attitude of the guards toward the men is kind, and considerate. No guard is allowed to use profanity when addressing a convict. The guards and the construction superintendent instruct the men as to how to perform the required service in a considerate manner, which instruction is received generally in the same spirit that it is given.

They are fed plainly but substantially. The general attitude of the men toward the work in hand and the conditions generally surrounding them is good. They frequently manifest interest in the work and rarely does discontent spread beyond a few.

As an example of discontent and discipline, the following was recently observed. A number of teams were grading. One of the drivers, a convict, stopped his team and refused to proceed. The guard in charge directed the other men to drive their teams around his. This was done for a considerable period of time, after which the disgruntled one resumed his work without further remark from the guard. Had the convict persisted in his stubborn attitude, he, no doubt, would have been returned to the prison, a thing most dreaded by one privileged to perform road work.

As examples of interest in the work, the following is mentioned: The prisoner operating a self-propelling street paver on the concrete road, who by the way was incarcerated for taking the part of a highwayman, was asked how he was getting along. The reply was, "all right except my engine is pounding considerably. I will fix it during part of my noon hour." The concrete mixer man on the same job was observed, without his knowledge, to shake his head regretfully when he discharged from the mixer a batch of poorly mixed concrete. General remarks concerning the day's work are heard from time to time expressing regret and satisfaction according to what was accomplished.

These facts are very important from a humanitarian point of view and cannot be disregarded when pure economics are being considered.

MR. ATKINSON (of Louisiana): I would like to ask one question; who was in direct charge of these convicts while at work? Who has the direct supervision and control?

MR. COLEMAN: The representative of the Highway Department, the superintendent or the engineer appointed by the Commission has full control.

MR. ATKINSON: And the captain and guards are under his orders and instructions?

MR. COLEMAN: Yes.

MR. ATKINSON: I want to say that we worked convicts in Louisiana a year and a half or two years, but the captains and guards were employed by the Board of Control and the engineer in charge did not have direct control of them, yet, we got along nicely and did good work; in fact our work cost us under the convict system about 50 per cent or not over 75 per cent, of single work under contract, and it has been proven to my mind that the system of working convicts on road work is very successful and is a very economical way of building roads. Now the cost to maintain these convicts in Louisiana was about 41 cents per man per day; that includes the maintenance of convicts and the guards' salaries and the captain's salary. The reason I asked about who had charge and full control of the convicts is that I believe we could have gotten better results if the Engineering Department had full control of convicts. For instance, the captain may have 3 or 4 flunkeys to wait on him and members of the guard would have 3 or 4 flunkeys and out of 40 or 50 men there may be 10 or 15 idle to act as flunkeys, but nevertheless under the system we have it has been proven to my mind that the convicts can be worked very successfully on road work.

THE CHAIRMAN: Mr. Johnson of Roswell, New Mexico.

MR. JOHNSON: *Mr. Chairman and Fellow Highwaymen:* I am not a highway engineer or road commissioner but I have a bond of relation to these brethren. You heard yesterday of the system of county roads at Charlotte and in Mecklenburg County, North Carolina. My wife's father was the chairman of the Board of Road Commissioners of Mecklenburg County for 30 years and built the first mile of their macadam road, which was the first mile of macadam road built in the South, so while I have no claim to a relationship directly, I have by marriage. I am a minister of the gospel; forced

some years ago to give up the work of an active city pastorate in Chicago by a nervous breakdown and compelled to live outdoors. I found more outdoors in New Mexico than anywhere else and have lived there for the last several years, and being unable to take up the active work of a pastorate, I have given the most of my energies to promoting the gospel of good roads. We have called upon the United States government to help us out of the mud. We have appealed to the boys and girls of our high schools to help us. We are now getting the coöperation of the ladies and I tell you it is time to ask the ministers and priests of this country to enlist in this campaign for good roads. Does not the Good Book say to make the crooked straight and the high places low and the low places high and to make smooth the way of the Lord? It is time that we interpreted that rightly. Does it not say that we live and move and have our being in Him? Well, the moving is pretty tough in some places and therefore good roads have a great deal to do with religion. I want to speak in support of two of the resolutions adopted here today and in the first place I want to show you some apples. These apples were grown a few miles west of Roswell, New Mexico, in the White Mountains, at an elevation of 5750 feet. It is 25 miles from the orchard to the nearest shipping point. The United States government has established the Lincoln National Forest there, has withdrawn the area from settlement and it is impossible for us to tax it to build roads, and those apples have to be hauled most of the 25 miles over federalized areas. Now I am feeding apples like these to the hogs out in Lincoln County, because the United States government has not thus far lifted a finger to improve the roads across its own land. Federal aid in our county means something, but it does not mean what it means in this convention. It means that we frontiersmen out in New Mexico have to aid the United States government to make the roads. Last summer I took my car and three men and went and fixed the impossible places on Uncle Sam's domain in the Lincoln National Forest on my way to my market and shipping point, and I then went over to the next county —I am set behind and before by the government; on one side is this Lincoln National Forest and on the other the Indian reservation— and I went over to O'Terrell County and asked the National Commissioner if they would fix up the worst places on the Indian reservation. It is the worst piece of road on the Southern National Highway which crosses it from here clear across to Santiago, and we have been trying for two years to get the government to appropriate the money to fix that road and they would not do it. So I went over to O'Terrell County got $1000 of their county road tax and fixed that place on Uncle Sam's Indian reservation. That is federal aid in my county. You have adopted a resolution in which you have joined us in trying to get the United States government to fix up the federalized areas. There are over 200,000,000 acres of land withdrawn from settlement in the United States, mostly

in the West, for Indian reservations, forest reserves and other federal purposes. You can go halfway across the 350 miles east and west across New Mexico, on those federalized areas, and two-thirds of the way across the State of Arizona on them, and if you take the map of the United States and look at those colored areas which show you how much of the great West has been withdrawn from entry for federal purposes, you will see that the adoption of that resolution, if it is carried into effect, will mean the building of thousands of miles of road that are needed on these great through routes to get yonder to the Pacific Coast and on to the wonderland of America, and I want you, when you go home, to take these resolutions, blue pencil them and send them to your representative in Washington and ask them to help us to develop the great West by getting appropriations to build those roads. There is another point I want to emphasize in this stretch of five minutes; I listened here to that magnificent address of Senator Hoke Smith; I listened to that splendid address of the President of the Southern Railway pleading for the market roads from the farm to the nearest market or shipping point; gentlemen, that is true of one-half of the United States, but you may draw a line from Winnipeg down to Bismark, North Dakota, North Platte, Nebraska; Amarillo, Texas; and San Antonio to Corpus Christi, and your map will show you that one-half the area of the United States lies west of that line and the other half east. You can call the eastern half the leaky half of the United States, because it rains so much and agriculture is the main interest; but the western part is the arid or semi-arid West. There are indeed exceptions, there are magnificent valleys like the one in which Roswell is located, with its 600 artesian wells. We have intensive cultivation of the soil, vast alfalfa fields, orchards of apples like these, 40 miles long and a dozen miles wide, but speaking generally, about one-half of the United States depends on mining, upon the live stock industry and upon the presence of the health seekers and the tourists for its prosperity. That happens to be that great West and we are vitally interested in these great through routes that will open up the lines of communication between the older part of the country that we call our home. We want these through routes that the people may come and see and get well and help us develop the magnificent boundless resources of our great West. We say that the United States is looking at this proposition with one eye when it ought to look at it with both eyes. When we find that the United States Office of Public Roads is simply a branch of the Department of Agriculture, we say that the Office of Public Roads should be a department by itself and we should have the through routes that are as essential to the development of our great country as it is that the farmer should have his. We want you to have your roads, that is the thing for Georgia and Iowa and the farming States, but we want you to help us to get our roads that are vital to the development of our country. Gentlemen I thank you.

THE CHAIRMAN: The Committee on Resolutions desire to make a report, after which we will take a recess until 2 p.m.

Mr. W. Tom Winn, Chairman of the Committee on Resolutions, presented the following resolutions which were, on motion, adopted.

FEDERAL COÖPERATION

Resolved, That the American Road Congress emphatically endorse the principle of federal coöperation toward the construction of main highways and thus assist the several States to build the main market roads in the one-half of the country which is devoted to agriculture—and to build through main roads in the one-half of the country which is not predominantly agricultural, but whose prosperity depends upon mining, the raising of live stock, and the presence of the health seeker and tourist.

STATE HIGHWAY COMMISSIONS

WHEREAS, The American Road Congress believes in and has long urged all States to enact uniform road legislation, and

WHEREAS, Experience has abundantly demonstrated that efficiency and economy are not obtained in the construction and upkeep of main roads, except by the coöperation of the States through skilled departments, and

WHEREAS, Forty of the forty-eight States have enacted State legislation; Georgia, Indiana, North Carolina, South Carolina, Tennessee, Arkansas, Florida and Texas, being the exceptions, and

WHEREAS, Federal aid and coöperation is near at hand, and it is probable that States having no highway departments will be unable to participate in such aid, therefore be it,

Resolved, That the American Road Congress in annual convention assembled in the city of Atlanta embracing several thousand delegates representing every State, reaffirm its belief that State Road Departments and State Aid are essential to secure efficiency and economy, and be it further

Resolved, That copies of these resolutions be sent to the governors of all States and to their various highway officials and that they be urged to promptly commend such laws to the legislatures in their respective States.

LINCOLN HIGHWAY

Resolved, That the Lincoln Highway Association be commended for its successful voluntary effort in arranging with counties, cities and townships for a connected series of roads across the United States, thus providing a definite and continuous route to be used wholly or in part by those who wish to become acquainted with the agricultural, mining and scenic advantages of their own land.

PUBLIC SAFETY

Resolved, That the American Road Congress deplore the frequent accidents on the public highways and urge upon the various highway officials or other authorities throughout the United States the enactment of the necessary rules and regulations to insure the public safety.

ROADS IN FEDERAL RESERVATIONS

Resolved, That the federal government be urged to build highways across all Indian and forest reservations and all other federalized areas, where such connecting links are essential parts of established through routes of travel.

COURTESIES

Resolved, That the sincere thanks of the American Road Congress be extended to the State of Georgia, the county of Fulton, the city of Atlanta and to the public press for their active coöperation, generous hospitality, and assistance generally in making this the most successful Road Congress.

November 12, 2 P. M.

DR. JOSEPH HYDE PRATT, CHAIRMAN

THE CHAIRMAN: The first paper on the program this afternoon is "Road Work by the Army," by Major Amos A. Fries, U.S.A.

ROAD WORK BY THE ARMY

MAJOR AMOS A. FRIES
Corps of Engineers, U.S.A.

This subject might be construed in two different ways; first, by the builder, as referring to the construction of roads, and second, by the man on foot, as referring to the use made of the roads. This last view is the one army men will appreciate most. To the weary soldier carrying his bed, board, and weapons, the road he is travelling over is a matter of supreme importance. This importance arises both from a consideration of his own personal comfort, and from his ability or inability, as the case may be, to get into a favorable position for battle.

Rapid marching has saved the lives of many soldiers, and won many battles. Napoleon in his many campaigns was the first great exemplar of this fact, and an able example of it in our own day was Stonewall Jackson's Shenandoah Valley campaign in 1862. Indeed, the Civil War furnished many examples of rapid marches that vitally influenced the fortunes of battles.

And just recently we have had some very brilliant exhibitions of rapid marching in the European War now in progress. The advance of the Germans through Belgium almost to the gates of Paris, as well as their later retreat to the line now held by them furnished a brilliant example of two things: thorough preparation beforehand, and the rapid movement of very large armies. This was true not only of the German armies, but of the French, English and Belgians, both in retreat and on the offensive.

Without good roads such rapid movements of vast armies would have been impossible. And thus again we see another example of how the arts of peace aid in the prosecution of war, or perhaps we ought to put it the other way, how the arts of war make for comfort in peace. Why? Because the first great builders of roads—the Romans—developed the art for the very purpose of moving their armies rapidly to any threatened frontier, and it was from them that the English, French and Germans got their first lessons, and their inspiration for good roads. And here we come to a truth that all we universal peace advocates—which all true army men are—must bear in mind, that is, that almost every art that makes for progress and comfort in peace has its uses in war. This is as true of powder as of roads, of tempered steel as of the clothing we wear on our backs. And until we can persuade the other fellow to abandon all thought of their use for war, we must continue to plan and prepare to use them ourselves in self defense, or else bow to the man who does use them for war purposes. Perhaps you think the statement that all true army men are for universal peace a case of poetic license, but most assuredly it is not.

The most advanced teachers who are fighting the vices that corrupt and kill, including the use of alcoholic liquors, depend upon instilling into the mind, particularly of the young, the horrors of succumbing to the vices they are attacking. Is it any wonder then that the army man with a loving wife and children is for peace, when all his study and observation impress upon him the hell that war is. But slavery, to an independent man, is a worse hell than war, and so the army man prepares for war hoping it may never come, but with the feeling that if the time should come when his country's freedom is menaced he can strike a telling blow for home and fireside.

This is a good deal of a digression from "Road Work in the Army," yet we all need once in a while to stop and realize how much our works built during peace for peaceful purposes will aid us to repel aggression in war, providing we are prepared for war, or if we are not prepared how much the same works may aid an enemy in overcoming us.

Road work in the army! No attempt will be made to outline the history of such work, as this was done in an able manner by Colonel Spencer Cosby, of the Corps of Engineers, in an address delivered before the Second American Road Congress, held at Atlantic City,

New Jersey, October 4, 1912, and published in the proceedings of that Congress, and in the Professional Memoirs, Corps of Engineers, U. S. Army, for July and August, 1914.

Briefly then, the army, and particularly the Corps of Engineers, has been engaged upon various classes of road work from the very beginning of our national life. These roads have varied from the crudest trails constructed under fire in the presence of the enemy to some of the finest roads and streets constructed anywhere in the country. Roads built by army men are found all over the United States, and our foreign possessions—in the tropics, in Cuba, the Philippines and Panama, in the frozen North in Alaska, in the lowlands of our coast, and in the mountains of Yellowstone Park.

As the writer is at present in charge of road work in Yellowstone Park it is believed a brief discussion of that work will prove interesting, since the conditions of work are unique, due to the high altitude of the park, and its location in the midst of the Rocky Mountains right in the path of the storms that, starting from Alaska sweep first southward, and thence eastward across the United States, only to disappear in the storm-lashed Atlantic.

To begin with, there are the tourists—God bless them—who alone make roads in the park a necessity, and who are, to say the least, an awful nuisance to working parties, and the cause of a great increase in cost in many classes of construction. This arises from the fact that the best, and in many cases, about the only working season, coincides with the tourist season. Then too, there are no automobiles, no railroads and no trolleys to facilitate and cheapen the supply and distribution of materials, and for hauling away excavated material of all kinds. Here the horse is supreme! mules, even, being rare.

Every State has its own problems in road construction, as is proper, but Yellowstone Park, being a national institution, would appear to have them all, which, while it may be proper all right, is most disconcerting to the engineer trying to build and maintain roads. Since without money there would be no road problems, and since Congress is the source from which money for Yellowstone Park comes, we will begin there.

The Congressional problem arises from fiscal year appropriations; that is, the money becomes available July 1st, if appropriated before that date, and if not, then, from the date of the appropriation, and must be spent by June 30th the following year or revert to the Treasury. Under ordinary circumstances a year is a year whether beginning in January or July, but circumstances, like everything else in the park, are extraordinary. There are few places where 4 feet of snow will fall in three or four days only to be washed away by 24 to 36 hours of violent thunder showers, and yet that is what happened September 12 to 20, this year.

One year the spring will be early, and work can be begun over most of the park in May and last into November, and the next work

can only be carried on at a few places before June 30, and may be stopped entirely early in October. At the best the winters are long and cold, and thus the second problem is what really makes a problem of fiscal year appropriations. Where work can be carried on for six months one year and only three the next one needs to be an Isaiah to tell what to do. If, as occasionally happens, the appropriation is made later than July 1st, the season is shortened just that much more. That was what happened this year, the season being shortened almost six weeks, and it has been even worse on some previous occasions.

If appropriations were made available until spent the amounts unexpended during a short season could be carried over into a longer one with great economy. As it is now, the engineer must push work in short seasons in bad weather when highly efficient work is impossible, or else turn most of his appropriation back.

Once again, the winters are long and hard, and are usually accompanied with very heavy snow-fall over nearly all portions of the park. In the higher altitudes the ground begins to freeze the last of September, and is often not completely thawed out until late in June of the following year.

As in all mountain roads grades are fairly frequent, and while kept to the minimum in the park there are quite a number of 6 and 8 per cent ones, with many of lesser degree. Due to the heavy freighting in the fall and again early in the spring the snow in the middle of the road is packed down and melted first, thus causing most of the water to run down the middle of the road—a frequent cause of serious injury to the natural soil surfaces that predominate throughout the park.

The tourist season lasts from June 15 to September 20, and this corresponds to the best working season, and in many years to the entire working season. The travel is heavy even in poor years, which naturally interferes greatly with the improvement of existing roads. For instance, every bridge rebuilt requires that it be constructed at a site different from the old one, or else that a temporary bridge be built so teams can get around it. In fact, all road work must be carried on so as not to interfere with the tourist coaches, and since only horses are used, and many grades are steep, with deep canyons on one side, and mountains or walls of rock on the other, extreme care must be used with all machinery and tools that might frighten the animals. In most places this means night work with road rollers and similar machinery, or the abandonment altogether of their use.

Tourists make park roads necessary, and they being mostly natural born Americans have the right to kick if things are not satisfactory, and many avail themselves of the opportunity. It was for this reason that some years ago the government began sprinkling the main traveled roads, and of course once begun it has had to be continued. And it is right too, but nevertheless it is quite a problem

to sprinkle 100 to 130 miles of roads, and do it efficiently on $15,000 to $18,000 per year.

If anyone doubts the propriety of sprinkling let him follow a long line of coaches over some hill that is not sprinkled, and if he isn't converted it can only be because he is so optimistic or angelic that his days on earth are numbered.

Oil has been under consideration as a dust preventive for some time, and has been tried a little the past summer, but arrangements to do the oiling were completed very late and only 3 miles of road were oiled. That 3 miles, however, indicated quite clearly that results will not justify the cost unless the roads are shaped and rolled hard just before oiling. Early next spring some gravel macadam will be given an oil and broken stone finish so as to form an oil macadam by the penetration process.

As discussed later the high cost of freight, both outside the park by rail, and inside the park by animal drawn freight wagons makes oiling very expensive as a general proposition. And as if cold weather late in the spring and early in the fall were not bad enough the rapid evaporation caused by an atmospheric pressure of about 11½ pounds per square inch reduces penetration, and may make advisable the use of a lighter oil than has been found best for road work in localities comparatively near sea level. There is no doubt that oil will work successfully on roads in the park, though experiment alone will determine the best kind of oil to use.

As found out in other localities oil on any but macadam of some sort is at best only a temporary expedient, and this brings us to another serious park road problem.

The ancient mariner sang: "Water, water everywhere and not a drop to drink," but the park engineer sighs and says: "Rock, rock everywhere and hardly a stone fit for road surfacing." This is scarcely conceivable in the heart of the Rockies, but it is a sad truth nevertheless. There are long stretches of road where no good rock is found, and where reasonably good gravel is almost unknown. On the other hand, there are a few places where there are unlimited amounts of good stone, but without power vehicles of some sort the cost of freighting metal more than a couple of miles is prohibitive.

The next problem is the large force of engineers, overseers, laborers and teams and the excessive amount of plant required, considering the funds available, all caused by a very short working season. Every construction engineer knows that a new crew works at barely 50 per cent efficiency for the first week or two, and if the crew puts in only seven or eight weeks the cost takes another jump. Furthermore, unless wages considerably above those ordinarily paid outside are offered few good men can be induced to come into the park, and up goes the cost another notch.

The park proper is almost three times as large as the State of Rhode Island, and has very nearly 300 miles of roads, of which 265 may be called main lines. Besides these there are approxi-

mately 100 miles of roads in the Forest Reserve east and south of the park that are more or less improved, and maintained as a part of the park system.

Supervision becomes a serious problem, and as the appropriations allow of the carrying over of only a small force through the long winters second grade foremen and overseers must be taken, or considerably higher wages than those paid elsewhere must be offered as an inducement to good men to come for the summer, and even then the lack of steady employment deters the great majority.

As previously stated, nearly all machinery is handled by teams, and as there is neither forage nor food to be had in the park all men and animals must be subsisted, and as freight is slow and expensive the question of supply alone is a very live issue. The government freight rate in the park is 26.8 cents per ton mile, and as the average distance from railroad connections to working points is 50 miles the cost for freight alone on materials, food products and forage used in the park is approximately $13.40 per ton. Railroad freight rates outside the park are high, due partly to the lack of both rail and water competition, but more to the distance of the park from centers of manufacture and commerce, the least distance to such centers being about 1000 miles.

As mentioned briefly early in this article the exclusive use of animal transportation in the park has made the use of gasoline or steam driven machinery difficult, and except for minor items the use of power driven machinery and vehicles during the tourist season has to be confined to the night time. While this increases the cost somewhat it is the belief of the writer that the use of such machinery and vehicles should be increased, even if all have to be operated at night.

Unless motor-propelled vehicles are allowed in the park the cost of freighting cannot be materially reduced, and this brings up another question of great interest to the general public and to those engaged in the business of feeding and transporting tourists in the park—that is—whether automobiles shall be allowed to use the park, or whether it shall continue to be kept exclusively for the use of animal drawn vehicles. As this is not an engineering question it will not be gone into further than to say that there are strong arguments on both sides, as anyone will find who studies the question deeply.

The original idea of the park was to keep it as nearly in its natural state as possible, and many feel that motor propelled vehicles would aid in destroying this primitive condition. On the other hand, there is greater speed and comfort in traveling in automobiles, besides the possibility of accommodating a greater number of tourists. However, it is questionable whether the decreased cost in transportation by automobiles over that for animal drawn vehicles will be a great inducement to the traveling public, since the greatest

cost to the average tourist is the railroad expenses incurred in going to and returning from the park.

The total spent on the roads in the park is $2,425,315.00, of which less then $3,500 per mile is for construction, the remainder being for maintenance. As park work began over thirty years ago, and as the roads have been kept open for traffic all that time the cost is reasonable for the character of the country through which the roads have been constructed. There are a number of difficult sections where the cost per mile has been many times the average, this of course being made up for in less difficult country. Another factor that must be kept in mine is that the appropriations at first were very small, and in order to build roads to reach the different points of interest they had to be built in the cheapest manner, which usually consisted in cutting out trees and brush, removing boulders and building bridges. Grades are often very steep, and when money became available for better construction these earlier roads had to be abandoned, and of course the money spent on them was lost, except that the public had the use of the old roads during their existence, and were thus enabled to see the park, where otherwise they could not have done so.

In general, it may be said that the present road system is excellent, and the original cost moderate, credit for this being due mainly to two prominent engineer officers of the army, Gen. Dan C. Kingman, Chief of Engineers, and Gen. H. M. Chittenden, retired. To General Kingman is due the credit for originating the idea of constructing a belt line road to connect the various points of interest, and afford means for making a complete circuit of the interesting points without traveling over more than a few miles of road the second time. In the four years General Kingman was in charge of the park roads, 1883 to 1887, appropriations were small, but the system was started, and later ably carried into execution by Gen. H. M. Chittenden.

The roads as built were surfaced with the natural material, such as gravel, earth, or rock nearest at hand, and in general they have served their purpose well.

As the park furnishes some of the most unique classes of scenery found anywhere in the world, and certainly in the United States, and as it is a magnificent summer resort the time seems to have arrived when the government can afford to spend such sums as may be necessary to make the main roads at least into first-class highways.

This is entirely outside of the question whether the roads shall be used for automobiles or be continued for animal drawn vehicles only, since in either case the roads should be first-class. The cost will be considerable for the reasons before mentioned, though judging from past results this cost will not be so very much more than for the same class of roads in localities where nearly everything that is difficult to obtain in the park is close at hand. In this connection it should be said that Congress has been liberal in recent years,

and is showing a desire to put the roads in first-class condition as fast as funds can be spared from the national treasury.

The study of how best to expend these funds is an interesting and serious one, and is being prosecuted with as much speed as natural conditions warrant. The park to any one who has not seen it is a revelation, and as it is a national institution it would seem proper for the writer to urge all those who have not seen it to do so at their earliest convenience, though the roads may not yet be the boulevards that are found in city parks throughout the country.

THE CHAIRMAN: We come now to a subject that is one of the most important in highway work, and that is, the question of contract work. The first paper is by John J. Ryan, Secretary, New York State Road Builders' Association. Mr. Ryan is unable to be present and has delegated the reading of the paper to Mr. T. Hugh Boorman, a highway engineer of New York, and a delegate appointed by Governor Glynn. I have the pleasure of introducing Mr. Boorman, of New York.

MR. BOORMANN: I believe that the time has about arrived when we shall have, as they have in France, a Federal supervision of roads. It is, to my mind, the one safe and proper way of attaining what this country should have, as we have, thank God, everything else of the very best. In reading this paper from Mr. Ryan, I wish to state that Governor Glynn and Mrs. Glynn both would have been very glad to have been with you. Governor Glynn has done excellent work during the short time that he has been the chief magistrate of the State, and it is worthy of much commendation. This question of convict labor he has taken up with excellent results. After these preliminary remarks I will get to the subject of Contract Work. I may say that here I am especially interested, because this paper is on the line of what I claim are constructors and not contractors. Any old bootblack can become a contractor; any fellow that has failed in the shoe business or even in the pulpit can become a contractor and lay cement sidewalks and patent pavements, but, as you will hear from Mr. Ryan's lips, he is a descendant of constructors; you will hear his views, in which I entirely coincide. He uses the word throughout, "real contractors," when I should put "constructors." I think you will see that the term "constructors" is really the more applicable.

POSSIBLE LINES OF IMPROVEMENT IN HIGHWAY CONTRACT WORK

By John J. Ryan

Secretary, New York State Road Builders Association

Real contractors and real engineers are born not made. A real contractor intuitively knows when, where and how to do the right thing; a real engineer knows how, when and where to plan the right thing to be done. A good contractor, even though tied up to a poor engineer, will be able to worry through and do good work; a first-class engineer, with a green contractor, will be able to complete a contract and show good results at the end, but when an incompetent engineer and a haphazard contractor find themselves on the same job, then there is trouble.

Unfortunately, in the highway contracting business there are a number of careless contractors and incompetent engineers, and for this reason, special attention should be given by States, counties and municipalities toward improving the methods of planning, letting, constructing and completing highway contracts.

Inasmuch as this article will deal with State and county roads, the suggestions will be from the view point of the contractor as to possible improvement in connection with State and county highway contracts.

When it has been decided by the officials of any State or county to build, or to improve a highway, the first step is to have a preliminary survey made, in order to ascertain the cost, so as to arrange for an appropriation covering the proposed improvement.

In the past it has been the general idea that a preliminary survey was merely an order from the Highway Department to send out a crew of young engineers on a cross country run. When this crew of sprinters started out on their preliminary survey they were allowed so many days, and generally this time allowance was so short that when the crew reached the road, the survey resolved itself into one hundred yard dashes with hurdles thrown in. There was so much surface skimming done that when the note-books made up by these engineers were returned to the office, they were found full of inaccuracies.

No time was spent by this marathon crew in seeking out information as to soil conditions, bad drainage, water flow of streams, property lines, deposits of road making materials, kind and amount of traffic, type of feeder roads, or any of the conditions which might have some effect on the selection of the proper type of road to suit that locality. Many a highway contract has been let where the type of road called for local materials, and no information has been given as to where these materials might be found in an acceptable quality. Special attention should be given by the survey party,

and it would well repay the Highway Departments, to see that these deposits of materials be sought out and properly located, in order that a correct estimate be made of the cost of the road. With a full and complete preliminary survey, the highway officials would be in a position to select the proper type, make an accurate estimate of the cost, furnish the bidders with detailed information concerning the materials to be used, and arrange to take care of the conditions affecting the life of the road; in short, cut the cloth to fit the form.

More roads go to pieces on account of poor judgment in the selection of type of road, than by poor workmanship on the part of the contractor. Yet, when one of these carelessly selected unfit types of road disintegrates, everybody jumps on the contractor and the engineer, even when they have followed the specifications to the letter.

When it has been decided to have a highway contract letting, the Department should consider seasons for such lettings. The late fall, winter and early spring are the best, inasmuch as the contractor has practically closed up his work, and has plenty of time to go over new jobs, and be in a position to bid intelligently on these contracts. The State or county would gain more by having lettings at these times, as they would receive more bids and, undoubtedly, fairer prices for work.

In connection with the letting of roads there seems to be a reluctance on the part of most Highway Departments to furnish information to bidders. Never yet has a State or county lost money by allowing a contractor to know in advance all that there was to be known about a contract which was advertised for letting. In New York State it has been the practice, after advertising highway contracts, to furnish the contractors with the engineer's figures showing how the engineer has arrived at his estimate by computing basic prices, with profit allowance. While some of the Old Guard of contractors state that they prefer no engineer's estimates to be given, yet, in general, the road builder in New York State looks for these estimates on each road, and checks up the same with his own idea of cost prices, making allowance for methods and supervision. It has yet to be found that the State of New York lost any money by this procedure; rather has it benefited by it, because the contractor when furnished with full information as to the contract, is in a position to bid closer and know what he is doing when bidding. This idea of giving the contractor every assistance possible before the letting, has brought about the circulation of tabulated sheets which show the item prices on each contract, and also state the amount of appropriation and amount of engineer's estimate. These tabulated sheets are of great help to the material and machinery men, and inasmuch as the shipping points are shown, the contractors are not guessing at the cost of imported materials, but have their quotations from the supply or machinery men days before the letting occurs.

On the day appointed for the letting, the bids should be in at a specified hour, and opened at that time and read publicly; reading every item, and also the total amount of contract price. This practice advised the contractor immediately whether his is a low bidder or not, and he is in a position to make arrangements about plant, materials and labor, pending the official award. This award should not be held up more than twenty-four hours, unless for some unforeseen cause. It ought not to take over twenty-four hours to make a recapitulation of any number of highway bids. In New York State, where on one day they have as many as thirty roads with three hundred bidders, the checking up is done at the same time the bids are read, and the award is made that day or the next morning. This allows the contractor to arrange for his bonds and the other necessities in connection with the preliminary part of his contract.

Performance bonds for highway contracts should not be over 50 per cent of the contract price. These bonds become a liability when the contractor signs them, and while it may be called paper liability, yet it has effect upon his credit and sometimes acts as a hindrance in securing other contracts. In some States they ask for a bond of 100 per cent, which is quite needless, and an inheritance of old and obsolete requirements. When a contract and bond have been signed by the contractor, and filed and approved by the proper highway officials, the contractor is generally ready to start things. He wants to be moving. It is not natural for the contractor to be hanging around the office. His work is energetic, and he wants to be doing something. This is the time where the accurate preliminary survey will show that certain materials have been tested and some found acceptable. The location of these acceptable materials designated, Mr. Contractor is now in a position to locate his machinery, make up his organization and get ready to start his job. Just before he gets this job started, however, it is necessary for the Department to have a representative on the work, and this representative must have some consideration. He is the mouthpiece for the Highway Department, and care should be taken in his selection, so that this mouthpiece be neither dumb, tongue tied nor voluble.

The growth of highway construction in United States has been so great, it has been almost impossible to find enough engineers who have a practical knowledge of road construction. For the most part, the road engineers are school boys plucked from technical schools and from civil service examinations, without an idea of practical road building, and sent out on the job armed with a book of specifications and set of blue prints. These young men are apt to be so afraid of themselves on account of their inexperience, they generally are so stiff that they lean backward. If there could only be a sort of preparatory school for young engineers who have been appointed to the Highway Department, and these engineers could

be given a few months of drilling in common sense interpretation of specifications, and then sent as assistants to old, practical engineers, who would be able to show them by their good example, that the engineer on the highway job is not supposed to be a detective, but an advisor and director, then there would be less friction and more and better roads built.

The accumulation of useless and obsolete machinery by the road contractor is one of the curses of the road building business. Every change of administration, every change of highway officials, brings about some new type of road advertised without any test or experiment. The contractor who secures it, finds that when he is ready to start work, he must go out and buy this or that kind of machinery, when he already has carloads of machinery rusting and falling away in some storehouse or yard. It is hoped by the active road builder, that some day there will be a millenium, when the types of roads will be settled upon, and everything standardized so that the machinery that is used in building them may be standardized also, and the contractor not put to the continued expense of buying new machinery and throwing away the old. The depreciation of machinery is big enough without having a loss on account of the constant changes in types of construction.

Suppose the contractor with a contract on his hands has worked his way through the initial stages, by locating his plant and organization on the job; suppose he has met his engineer, with the hope that he will find him of some breadth and capacity; suppose work is started and the machinery put in operation, and everything running smoothly; then comes some little question as to the interpretation of the specifications, here your Mr. Road Engineer, if he be one of those near-sighted, hair splitting, afraid-of-his-life young men, he will get so fine in his decisions that he will forget all about the fact that he is building roads, and will try to build watches. These watch builders are the bane of highway construction. Never yet was a road built by a watch builder. A road has to be built by a road builder. You cannot have hair line decisions on road work. No blame for this can be applied to the Highway Departments. The trouble is the dearth of good, practical and competent road engineers. The failure of an engineer on the job, to make timely decisions in reference to materials or questions that come up in the course of construction, has brought about losses in highway construction, not only to the contractor, but to the Department.

The monthly estimate is the vital thing to the contractor. There can be no successful contract without prompt monthly estimates. They must not be irregular or pruned. Monthly payments to the builder are as food to the body.

In some States 90 per cent of the monthly estimates taken about the twentieth of the month are paid before the first of the next month, that is, practically all monthly estimates are paid within ten days. That is a fact, and records in the New York State High-

way Department will show these statements to be true. If New York State can do it, other States can do it. It only means, make the engineer keep up to his job, and make the contractor keep up to his.

When the first monthly estimate comes around the contractor, if he is a real, live contractor, will have his cost data and his monthly reports figured so that he knows how much work has been done, and how much it has cost him, and he is then in a position to take up the matter with the engineer. Together they can check up and agree upon what the estimate should be, so that there will be no deficiency when the check comes to the contractor. Every contractor should keep accurate account, by daily time reports, of every one on his payroll, of the time and amount of work done. Only in this way can he keep tabs on his job and be in a position to put up a fight for what is his when the estimate time comes around.

If more attention was paid by road builders to cost data, there would be fewer disagreements with engineers about how much was coming to them. The right kind of an engineer is only too glad to check up with the right kind of a contractor. Of course, there are exceptions where this checking might lead to some wrong doing, but today, this is almost impossible, and on good straight contract work the final estimates would show over-paying and would bring out the fact that there had been collusion. Item prices and publicity tend toward minimizing the chances of collusion between the engineer and contractor.

When it comes to the completion of a highway contract there should be no delay in its acceptance. The engineer should follow the contractor's work with his final cross sections, and be ready to send in the final quantities, in order to pave the way for speedy payments.

One of the great drawbacks to the highway contracting business is the long delay in final payments on roads. The contractor is sometimes held up for months, and in addition to the 10 or 15 per cent of retained money, there is generally the last monthly estimate. This is apt to have a contractor tied up and his credit questioned by banks, material and machinery men. The margin of profit is too small to allow of long deferred final payments. The contractor is advancing most of the money, and with the large retained percentages, he is handicapped in arranging for new work, and paying off the liabilities which have accumulated on the previous contract.

Up to a short time ago, it was the practice in several States for the engineers out on highway work during the summer, to hold back their final cross sections and quantity sheets until they were called into the main office for winter work. They hung on to these estimates like grim death in order to string out their time during the winter. Mr. Road Contractor was wearing a path to the Highway Department trying to get the money due him. This was unfair to the contractor, and to those depending upon him for payment of accounts.

The road builder who knows that his final moneys will be paid to him within thirty or sixty days after the acceptance of his contracts, is in a position to do better work and at a little less money than the man who is paying interest notes in the banks, and on notes to machinery men, and having a hard time to meet the payrolls on other work.

In some States the Highway Department has made a record in the way they have handled these final payments, and the contractors in these States are the best in the business. It is a fact that when the Highway Department tries to help the contractor, the contractor is there to help the Department.

Contractors do not get together as often as they ought. Road officials and engineers have conventions, State and national. No body of men engaged in the same line of business ever assembled without some good coming to the individuals. Exchange of ideas in reference to methods of supervision, operation of machinery, manipulation of materials, etc., is bound to help the practical end of road building.

Highway contracting today is an industry large and extensive. It will be greater in the coming years. The interest in good roads in States just awakening, is going to mean more highway contracts, more highway contractors, and more highway engineers. Highway improvement is being benefited by the interest shown in it by the public; and it is by such conventions as this, where officials, engineers and contractors discuss subjects of common interest, that improvement along standard lines of highway contract work will be secured.

DISCUSSION OF POSSIBLE LINES OF IMPROVEMENT IN HIGHWAY CONTRACT WORK

L. D. Smoot

Commissioner of Public Works, Jacksonville, Fla.

Real contractors and real engineers are born not made. A real contractor intuitively knows when, where and how to do the right thing; a real engineer knows how, when and where to plan the right thing to be done. A good contractor, even though tied up to a poor engineer, will be able to worry through and do good work; a first-class engineer, with a green contractor, will be able to complete a contract and show good results at the end, but when an incompetent engineer and a haphazard contractor find themselves on the same job, then there is trouble.

Unfortunately, in the highway contracting business there are a number of careless contractors and incompetent engineers, and for this reason, special attention should be given by States, counties and municipalities toward improving the methods of planning, letting, constructing and completing highway contracts.

Inasmuch as this article will deal with State and county roads, the suggestions will be from the view point of the contractor as to possible improvement in connection with State and county highway contracts.

When it has been decided by the officials of any State or county to build, or to improve a highway, the first step is to have a preliminary survey made, in order to ascertain the cost, so as to arrange for an appropriation covering the proposed improvement.

In the past it has been the general idea that a preliminary survey was merely an order from the Highway Department to send out a crew of young engineers on a cross country run. When this crew of sprinters started out on their preliminary survey they were allowed so many days, and generally this time allowance was so short that when the crew reached the road, the survey resolved itself into one hundred yard dashes with hurdles thrown in. There was so much surface skimming done that when the note-books made up by these engineers were returned to the office, they were found full of inaccuracies.

No time was spent by this marathon crew in seeking out information as to soil conditions, bad drainage, water flow of streams, property lines, deposits of road making materials, kind and amount of traffic, type of feeder roads, or any of the conditions which might have some effect on the selection of the proper type of road to suit that locality. Many a highway contract has been let where the type of road called for local materials, and no information has been given as to where these materials might be found in an acceptable quality. Special attention should be given by the survey party, and it would well repay the Highway Departments, to see that these deposits of materials be sought out and properly located, in order that a correct estimate be made of the cost of the road. With a full and complete preliminary survey, the highway officials would be in a position to select the proper type, make an accurate estimate of the cost, furnish the bidders with detailed information concerning the materials to be used, and arrange to take care of the conditions affecting the life of the road; in short, cut the cloth to fit the form.

More roads go to pieces on account of poor judgment in the selection of type of road, than by poor workmanship on the part of the contractor. Yet, when one of these carelessly selected unfit types of road disintegrates, everybody jumps on the contractor and the engineer, even when they have followed the specifications to the letter.

When it nas been decided to have a highway contract letting, the department should consider seasons for such lettings. The late fall, winter and early spring are the best, inasmuch as the contractor has practically closed up his work, and has plenty of time to go over new jobs, and be in a position to bid intelligently on these contracts. The State or county would gain more by having

lettings at these times, as they would receive more bids and, undoubtedly, fairer prices for work.

In connection with the letting of roads there seems to be a reluctance on the part of most Highway Departments to furnish information to bidders. Never yet has a State or county lost money by allowing a contractor to know in advance all that there was to be known about a contract which was advertised for letting. In New York State it has been the practise, after advertising highway contracts, to furnish the contractors with the engineer's figures showing how the engineer has arrived at his estimate by computing basic prices, with profit allowance. While some of the old guard of contractors state that they prefer no engineer's estimate to be given, yet, in general, the road builder in New York State looks for these estimates on each road, and checks up the same with his own idea of cost prices, making allowance for methods and supervision. It has yet to be found that the State of New York lost any money by this procedure; rather has it benefited by it, because the contractor when furnished with full information as to the contract, is in a position to bid closer and know what he is doing when bidding. This idea of giving the contractor every assistance possible before the letting, has brought about the circulation of tabulated sheets which show the item prices on each contract, and also state the amount of appropriation and amount of engineer's estimate. These tabulated sheets are of great help to the material and machinery men, and inasmuch as the shipping points are shown, the contractors are not guessing at the cost of imported materials, but have their quotations from the supply or machinery men days before the letting occurs.

On the day appointed for the letting, the bids should be in at a specified hour, and opened at that time and read publicly; reading every item, and also the total amount of contract price. This practice advised the contractor immediately whether his is a low bid or not, and he is in a position to make arrangements about plant, materials and labor, pending the official award. This award should not be held up more than twenty-four hours, unless for some unforeseen cause. It ought not to take over twenty-four hours to make a recapitulation of any number of highway bids. In New York State, where on one day they have as many as thirty roads with three hundred bidders, the checking up is done at the same time the bids are read, and the award is made that day or the next morning. This allows the contractor to arrange for his bonds and the other necessities in connection with the preliminary part of his contract.

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heritance of old and obsolete requirements. When a contract and bond have been signed by the contractor, and filed and approved by the proper highway officials, the contractor is generally ready to start things. He wants to be moving. It is not natural for the contractor to be hanging around the office. His work is energetic, and he wants to be doing something. This is the time where the accurate preliminary survey will show that certain materials have been tested and some found acceptable. The location of these acceptable materials designated Mr. Contractor is now in a position to locate his machinery, make up his organization and get ready to start his job. Just before he gets this job started, however, it is necessary for the department to have a representative on the work, and this representative must have some consideration. He is the mouthpiece for the Highway Department, and care should be taken in his selection, so that this mouthpiece be neither dumb, tongue-tied nor voluble.

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Suppose the contractor with a contract on his hands has worked his way through the initial stages, by locating his plant and organization on the job; suppose he has met his engineer, with the hope that he will find him of some breadth and capacity; suppose work is started and the machinery put in operation, and everything running smoothly; then comes some little question as to the interpretation of the specifications, here your Mr. Road Engineer, if he be one of those near-sighted, hair splitting, afraid-of-his-life young man, he will get so fine in his decisions that he will forget all about the fact that he is building roads, and will try to build watches. These watch builders are the bane of highway construction. Never yet was a road built by a watch builder. A road has to be built by a road builder. You cannot have hair line decisions on road work. No blame for this can be applied to the Highway Departments. The trouble is the dearth of good, practical and competent road engineers. The failure of an engineer on the job to make timely decisions in reference to materials or questions that come up in the course of construction, has brought about losses in highway construction, not only to the contractor, but to the departments.

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wrong doing, but today, this is almost impossible, and on good straight contract work the final estimates would show over-paying and would bring out the fact that there had been collusion. Item prices and publicity tend toward minimizing the chances of collusion between the engineer and contractor.

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Mr. Shirley takes the chair.

THE CHAIRMAN: The subject of the next paper is Highway Engineering Education, by Prof. C. M. Strahan, Dean of Engineering, University of Georgia. It gives me pleasure to introduce Professor Strahan.

HIGHWAY ENGINEERING EDUCATION

C. M. STRAHAN

Dean of Engineering, University of Georgia

A friend of mine from Muscogee County, said to me that the three fundamentals of building good roads were a negro, a mule, and brains. I take it that we are now concerned with the question of the kind of brains required and how to get them. The universities are regarded as the chief brain factories of the country. We naturally look to them for road building brains—what can they supply? Or rather what ought they to supply? By adopting the military analogy we may possibly classify the answer. The army needs the brains of the general, of the major, of the lieutenant, of the non-commissioned officer, of the private—it needs them for infantry, for cavalry, for artillery.

We cannot expect West Point to turn out ready made generals—we are content to accept second lieutenants. We cannot tell which of these lieutenants is going to be the ultimate general, or whether his future will run to infantry, cavalry, or artillery. We do know that experience must be added to early training before the finished product will be wrought.

So in regard to the education of highway engineers, the university must direct its undergraduate effort to making the well drilled subofficer rooted and grounded in the fundamental truths of his profession capable by opportunity and experience of serving in a specific arm of the service and growing more and more into perfect power as the result of that experience and his personal initiative. The West Point graduate is not a specialist in infantry maneuvers, in cavalry evolutions, artillery ballistics. He has been taught the principles and chief practices of them all. He specializes afterward. His ultimate efficiency as a higher officer lies in his ability

to direct his energy wisely in relation to the whole army and to the exigencies of that part of the fight in which he is actually engaged.

The young highway engineer enlists in one grand division of the great civil engineering army. He is required to serve in one company of this division. He hopes for promotion. Manifestly his training should be broad enough to include not simply the work of his company but of his whole division. But even then suppose he is a misfit! He may properly belong to the Sanitary Corps. The university must bear this in mind, both for him and for the highways. It must remember that the item of experience, the item of personality, powerfully modify the quality of brain product. Fortunately justice can usually be done to both sides if a too narrow undergraduate training is avoided. There underlies the whole field of civil engineering knowledge a limited number of sound physical, mathematical and chemical ideas. To select and emphasize these fundamentals, to vitalize them by an adequate but too multiplied number of variety of practical applications is the real problem of the engineering school.

The same kind of moments and shears are at work in the highway bridge as in all bridges. The construction details differ. A limited number of typical bridge designs, not every possible design, has place in the undergraduate course. The same principles of drafting cover the railroad map, the architect's plans and the highway lay-out. The same principles of mathematics apply to quantitative estimates whether of masonry, or water, or earth work. The natural properties and suitabilities of stone, of brick, of cements and concretes, of sand, of clay, of metals, are fundamental to the selection for structural use of any kind. The special adaptability of each or in combination is perfected in the engineer by research and structural experience. The university can here give valuable partial demonstrations and data up to a certain point. It can reveal the laboratory point of view through experiments and tests on the more important materials. The engineering experiment station and testing laboratory with their trained specialists must continue this research work.

The broad principles and significant facts of hydraulics are also fundamental to the highway engineer as to any other engineer. Let him understand these principles and he will readily grasp the coasting of his road surfaces, the undermining of his bridge piers, the capacities of his side ditches and culverts. The writer forbears to press this line of thought further.

Engineering efficiency of the individual then consists:

1. In broad and firm grasp of the physical, chemical, quantitative and qualitative relations of natural and manufactured materials and of the forces at work on them.

2. The utilization and management of men, of motive power, of machinery to accomplish definite structural ends with these materials.

There are three principal things to be done:

1. Certain field operations in laying out the proposed work.
2. Certain office drawings and calculations to make clear the purpose and the construction contemplated.
3. The actual performance of the construction by the best agencies and materials.

The university can give insight into materials of important kinds, it can give training in typical surveys, in office drawings, in mathematical calculations, in principles of design and in theories of the action of forces. It cannot give experience and judgment in the control of labor or the final economics of motive power and machinery. The writer would therefore be content to turn out highway second lieutenants with the possibility of their becoming by experience, majors in earth roads, colonels in concrete roads and chiefs of staff on highway commissions. He would rely on the graduate school, the research laboratory and the field construction, to effect the successive promotions from grade to grade.

He would avoid the inadequate foundation in the young highway engineer's mental training as zealously as in the road he is expected to construct.

THE CHAIRMAN: Gentlemen, I have the pleasure of introducing Mr. D. J. Morrison, of Mississippi.

MR. MORRISON: Gentlemen, I have the honor to represent as chairman, the Mississippi delegation to this convention appointed by our governor.

The thought has come to my mind by the speeches and the general type and character of the delegation represented here that the momentous question before this Congress and the American people is transportation and its methods.

Without transportation the past would be forgotten, the present grow dim, and the future be blotted out. Transportation is the connecting link between sorrow and happiness, between failure and success, between ignorance and intelligence, between darkness and light, between heathenism and civilization, between despair and hope, between war and peace and between death and life. Transportation first led our primitive ancestor from his benighted hut along a stony footpath to the brook for water, or over the bosom of some lonely lake in his boat of bark or skin in quest of food to the great double track trunk railway lines of today, or to the mighty steamships that traverse the seas and touch all the remotest lands of the world. Transportation transformed the call of communication of this ancestor of ours to his neighbor across the brook to the wireless voice of the Marconi system of telegraphy heard now across the oceans and seas by every land of the globe. Transportation transformed the falcon or the carrier pigeon to the armoured airships of today. In proportion as the method of transportation is intensi-

fied its use is diminished. Wireless telegraphy is the most intense physical mode of transportation and closely approaches the swiftness and speed of human thought. Wireless telegraphy, airships, waterships, telephones, telegraphs, electric and steam railways all are intensified methods of transportation, and in their use are more or less diminished in comparison to the great public highways of our country upon which the masses must depend for their mode of transportation, and over which must be transformed from the fields food and clothing to the teaming millions of the world.

Is it not amazing and incomprehensible with such a stupendous factor as good roads to increase the wealth of our nation, and raise the standard of our citizenship to such a high efficiency our Federal Government has done so little to aid this department. Why should not Congress long ago ranked the department of public highways among the first of importance of her economic questions. I say this is strange and incomprehensible when Congress has done so much and spent so much money in other ways. Can any appropriation develop greater resources and wealth or reach a greater number of people than the farmer who holds the real wealth of the nation, than an appropriation for improving country highways?

Congress appropriates large sums annually for building and maintaining levees, harbors, canals, and railroads, and still other large sums to protect our health in the pure food act, in the quarantine act to protect us from outside competition in the tariff act, to protect us from extortion, transportation rates in the interstate commerce act. Much money is spent by other acts, namely—to teach us how to grow two blades of grass where one grew, two ears of corn where one grew, two bales of cotton where one grew, how to kill the lady-bug, the potato bug, the Egyptian moth, the boll weevil, and many other acts looking to protect and better the condition of the farmer. The Federal Government pays large sums to railroad companies for transporting the mail over their roads, yet, how many dollars are paid by the Federal Government for building and maintaining public roads over which thousands of tons of mail is transported daily by the parcel post and rural delivery routes. This seems that the Federal Government has subsidized our public roads and appropriated their use for the mail service without paying a dollar for the privilege to the country through which they pass. To the contrary the United States claims the supreme right of way over them.

Our congressmen and senators are directly responsible for these inequalities of rights and benefits and the representatives of our legislature are under the same indictment.

The solution of building good roads throughout the length and breadth of this country is in the hands of the people, and especially the farmer, who has always been the idol and hero of the politicians' campaign, until the election is over. Let the eternal question burn its way into the legislature and Congress by the voters, "Will you if

elected support State and national aid for public highways." When this is done we will be sure to get this all important aid.

The Southern States need good roads more now than ever, since cotton has ceased to be the wealth of our crop, on account of the boll weevil.

A bale of cotton under normal conditions is worth $50.00 and weighs 500 pounds. To equal this value of $50.00 in native hay we have a weight of 10,000 pounds, and in corn a weight of 6,000 pounds. Forced to largely abandon raising cotton we must raise products of higher tonnage, and the transportation of this high tonnage is the factor that demands immediately a larger field of improved highways for the South.

A Mississippi highway association growing out of this Congress among the delegates appointed by Governor Brewer has been formed, and I have the honor of being its president, and I hope that when our next legislature meets you will find Mississippi transferred from the delinquent list and among those States who have a Highway Department.

Gentlemen, as chairman of the Mississippi delegation I submit to you the following report of what our State has done in four years even without a public highway department from which I could gather data. This report does not include work done by tax levy, but only that by bond issue.

Amount of money raised by bond issue		$5,920,500.00
Number of miles of gravel roads built	717.41	
Number of miles of macadam roads built	137.13	
Number of miles of sand, clay and dirt roads built	5381.00	
Number of miles of concrete roads built	31.00	
Number of miles of different kinds of roads now under contract	3272.00	
	9518.54	
Approximate amount of money on hand for future contract or uncompleted contracts		$1,139,500.00

THE CHAIRMAN: Continuing the subject of highway engineering education, I now have the pleasure of introducing Prof. Hector J. Hughes, Chairman of the School of Engineering, Harvard University.

PROFESSOR HUGHES: Engineering education is usually taken to mean the technical education comprised in a limited period of four years, more or less, pursued at a scientific school or college; and it is my conviction that many of the difficulties which confront us in connection with this subject are due to a point of view which leads us to look upon this period, which is only a short step in the process of education, as its end and goal. Moreover, although engineers and administrators and engineering teachers know pretty well

what is essential and desirable for young students intending to enter upon highway work, there is a considerable divergence of opinion as to the best way to organize instruction; and there are also many limitations imposed upon the technical schools by factors and influences beyond their control.

We are at present confronted with a demand for trained highway engineers much larger than the supply. This is partly because the field is new, and experienced men are relatively scarce, and partly because the engineering schools have not developed their highway work as well as older subjects of instruction. Moreover, this very lack of experienced highway engineers, accentuates the deficiencies of young graduates when they enter this field because they are, at the beginning of their careers, called upon for a degree of skill and knowledge of practice which is to be gained only by experience, and to fill places which in other fields are commonly held by older men. We should meet the immediate demands thoroughly, and train our students to profit by this present opportunity; but we should not forget that the condition is abnormal, nor embark upon educational policies which may result, sooner or later, in conditions which may be disadvantageous to the engineers themselves, as well as to the community which they serve.

We too often discuss engineering courses as if the education of engineers were comprised in the short period spent in a technical school, and plan the subjects of study as if young graduates were finished products. If they often fall into that fatal mistake themselves, they are hardly to be blamed; yet we know right well that they are only beginners in their profession, that their education begins with their first mental impressions in infancy, that their character and their habits of work and thought are more or less determined before they enter college, and if their education is to end when they graduate, as sometimes happens, time and money and effort have been wasted in starting them on ineffectual and disappointing careers.

It is not too much to expect that young engineering graduates should leave the technical schools mentally equipped to enter upon practice in any one of the several closely allied fields of work, with the expectation that continued further study combined with experience will lead to expertness and suitable rewards. When there were only a few special fields of engineering, the task of the schools was simple, but with the growing and inevitable development of specialties, the schools are facing difficult problems in trying to meet the demand for more specialized training without sacrificing subjects which are commonly held to be both fundamental and indispensable. The problem reduces itself in the last analysis, to the best use of time and money; the time required to complete not only a technical course, but also the whole course of schooling, the money spent in providing educational opportunities, and in supporting students a considerable period of their life in unproductive effort.

Engineering students of this country rarely carry their schooling beyond the four-year undergraduate courses of the engineering schools. A small percentage of our engineering students go to college before entering upon their professional studies, another small percentage take an additional year or more of advanced specialized engineering work; this small but important class should be well provided for, but the four-year undergraduate courses are our chief concern.

The average age of entrance to the technical schools is probably between 18 and 19 years, and the age of graduation between 22 and 23 years; and the four years in the schools comprise in reality only four periods of about thirty weeks each, with perhaps an additional ten weeks in the summer, making the whole period specifically devoted to what we call a technical training, about one hundred and thirty weeks, or two and a half full years. About one-half of this period is allotted to subjects which are not technical, although many of them are necessary preparation for applied science or engineering subjects which we are accustomed to look upon as the real technical training. In these four years, or to be more exact two and a half years, students are expected to become intelligent observers, industrious, clear and logical thinkers; to learn to express themselves correctly and clearly in speech, in writing and in drawing; to acquire skill in the use of mathematics and mechanics; to get a fundamental knowledge of four or five physical sciences and be trained in laboratory methods; also to become thoroughly grounded in the applied sciences (that is, the engineering subjects of one general field of engineering), and to acquire some skill in the use of engineering instruments. To this is usually added the study of one or two foreign languages, sometimes economics, literature and history.

As highway engineers, they should learn of the materials, processes and methods used in all kinds of roads and pavements; they should be trained in making physical and chemical tests of road materials, and interpreting these tests; they should be trained in location and design, in writing specifications; and should know something about road economics and administration, and road laws, and be familiar with good practice in general.

It is only necessary to enumerate these subjects to show that the proper accomplishment of all the training desirable is not possible within the limited period available. The necessary stress under which the students work often defeats the very object of their education, namely, a thorough training of the mind.

The technical schools have met the demand for specialization in several ways. (1) By establishing advanced graduate courses which recognize the fact that to be effective, specialized work should be based upon thorough training in fundamentals. Such courses are naturally only available for those who have completed the undergraduate work. While this method solves the problem for

those few who can afford the time and money, it does not solve the problem for the average student. There should be a few schools well equipped and well manned to provide this class of instruction for very promising men, and for those who wish to return from practice to acquire additional special knowledge in the fields into which choice or circumstances have placed them. But it is not a general solution, even if students could accept it, certainly not unless it could be accomplished without increasing the age of graduation, which is very high at the present time.

(2) A second method is to add to the technical programs, courses giving the salient points of special fields, as the demand for one after another arises, attempting to keep more or less intact the fundamentals of the original programs.

(3) The third method is to offer optional groups of study in special fields, eliminating part of the subjects formerly required of all students.

The second method is not satisfactory in general, as it often results in eliminating much of the desirable drill in fundamentals and in replacing it with informational courses, rules of thumb, and hand-book designing, routine drafting, and the mechanical performance of laboratory exercises.

The third way is probably the best that can be done if we must specialize in the time allotted to the undergraduate courses. By this plan students can acquire a fundamental knowledge of the mechanics, and a good beginning in one field of engineering without sacrificing vigorous mental training. But under such specialization the students are too often inadequately prepared to enter advantageously other fields than the one which they have chosen; and if they do not select the fields where the opportunities of their own future may lead them, they may be permanently handicapped by the narrowness of their training.

A study of the catalogues of engineering schools will convince anyone that some schools have met this matter of specialization squarely, that many have not, and that some programs are a compromise between an attempt to specialize and still to retain all the fundamental subjects. It is not uncommon that students carry ten, twelve or even more separate courses simultaneously through a term of fifteen weeks. These courses vary from a lecture of one hour per week in each subject to drafting or laboratory courses of six hours or more a week. Some of the courses neither require mental effort, nor produce any mental reaction, and in many instances the programs are so crowded that there is little opportunity for mental digestion. We are in theory at least training young men to solve engineering problems, and if they are not trained to think, the very end of education is defeated. Too often all but the most vigorous students take degrees and enter upon their professional work filled with undigested facts, but little competent to meet and solve real problems.

It seems pertinent to raise the question whether many existing programs in our engineering schools are not more or less haphazard development from courses originally designed to train students primarily for corporation service. What we need at the present time, as a prominent engineer recently said, is to educate engineers for public service as well as for corporation service. They should have the technical subjects, but they should also have training in business administration, financing, in organization, and the principles of accounting, and in matters which pertain to the commercial, industrial and civic institutions of the country. And above all they should be fitted to take up engineering problems, not only from a technical standpoint, but also with the broadest and soundest consideration of all the elements involved.

But it will be asked how can we do all that is now being required in the time available, and add more to it. Perhaps we cannot, but we can, I think, improve the training of our students without adding to their years of study or increasing the age of graduation. Under the existing conditions of entrance, and with the preparation which students ordinarily have upon entering college, the betterment of the technical course is to be found in the simplification of the programs, in the elimination of over-specialization, in a more thorough correlation of subjects, and in the reduction of the number of subjects attempted. And by specialization, I do not refer merely to new fields; I believe it is entirely possible to over-specialize, to the disadvantage of the students, in certain elementary subjects, such as drafting and surveying, and in the most advanced subjects, such as railroading and structures. It is quite possible to provide within the limit of the four-years' course, a well balanced program which will give civil engineering students about an equally good preparation in the fields of highway work, structural work, water power, railroad and sanitary engineering, and make every part of the program a vigorous course in mental training.

I think, however, that if we stop there we fall short of solving our problem. We are too much given to thinking in terms of the four years of the technical courses, forgetting the other twelve or more of earlier schooling, and the years of study which should follow in the career of every engineer. We teachers know that many, if not the majority of students enter the schools with careless and slovenly mental habits; many cannot write or speak correctly and clearly, and many cannot do arithmetic or elementary mathematics accurately. And, although considerable effort and much time is given during the four years to correcting early acquired habits, engineers and teachers know that many leave the schools with more or less the same unsatisfactory qualities that they had when they entered. Moreover, much time is spent in college in repeating subjects which the students have already studied long enough to master up to a certain point, but which they have not mastered, and too much time is given to studying subjects which can be as well or better studied

at an earlier age. Higher standards both for entrance to, and graduation from our technical schools should be more uniformly enforced.

It has been repeatedly asserted by competent educators that at least two years can be saved in the secondary schools, and that students can be graduated two years earlier from college if a better coordination of work between the secondary schools and the colleges could be secured; and this does not take into consideration the fact that a large amount of time is wasted for the older boys and college students in the long summer vacations. Two years added to the productive period of college graduates would be great economic saving, to say nothing of the possibilities it would offer for adding to the present course certain studies which are highly desirable and which in many instances could be added if it were not for this waste of time. It is certainly possible to fit all of our students to enter college at least one year earlier and to make available considerable time out of the four years for such studies as engineering students ought to take to fit them for the business and administrative duties which they may be called upon to perform.

A radical reform in the use of time during the years of schooling concerns not only highway education but all education, and will certainly come to pass under the stress of a growing economic necessity, but it seems to me that these reforms should be hastened by every influence that engineers and others interested in the welfare of young men can bring to bear. It is especially important in engineering because the majority of engineering students do not come from wealthy homes and the cost of instruction, as well as the cost of supporting them while they are not earning, is a very heavy tax not only upon their parents, but upon the community. Moreover, the years of apprenticeship of young engineers are long and their salaries are small. Students should enter upon their work not only as early as possible, but also as well equipped as may be, not only for highway engineering, but within reasonable limits for any engineering work that the chances of life may offer them.

THE CHAIRMAN: Next on the program is the Washington-Atlanta Highway, by Charles P. Light, Field Secretary of the American Highway Association, but Mr. Light's duties have been so numerous that he has asked Mr. George C. Scales, Highway Engineer of the U. S. Office of Public Roads, to take his place.

MR. SCALES: *Mr. Chairman and Gentlemen:* I know you missed a treat by not hearing Mr. Light, as I am a very poor substitute for him when it comes to speaking. I will try in as few words as possible to tell you what we are trying to do. For about 20 years the Office of Public Roads has been building object lesson roads all over the United States, collecting cost data and having bulletins printed to be used in different parts of the country, but no systematic attempt at maintenance has been made except in the case of a few

high priced roads. The American Highway Association made a proposition to the U. S. Office of Public Roads that if they could get about 1000 miles of roadway, they would try out the question of maintenance; the Office of Public Roads to detail three engineers for the work and the American Highway Association to furnish three automobiles for the use of the engineers. The road from Washington to Atlanta was selected. It is a road that comprises about 95 per cent of all the types of road in the United States. They wanted to get the coöperation of all the counties along the line of this road, because the United States was not going to spend any money whatever. They met with hearty coöperation and inaugurated the scheme, and in May appointed three engineers, Mr. Winslow for the northern division, myself for the southern and Mr. Spoon for the center. The idea was for the counties along this road to set aside a thousand dollars a year for maintenance to be spent under the supervision of the U. S. Government engineers. In Virginia at the present time they have about 200 miles of 275 under maintenance. The plan has just been started. In South Carolina and a part of North Carolina they have about 50 miles. On my section of 300 miles in Georgia I haven't any under maintenance yet, for the following reasons: the counties have spent about $25,000 so far in widening the roads, putting in pipes where they formerly had wooden culverts, and putting on soil. In the next three or four months there is going to be a great deal more money spent and I did not want to put them under maintenance until they were in such shape that they could be maintained. The original idea was to have a single road from Augusta to Atlanta, but there was so much rivalry that they finally took both, so the line split at Thompson, Georgia, one part going by way of Washington, Lexington, Athens, Monroe, Stone Mountain, and the other by way of Warrenton, Coffinsville, and Latonia. The roads have been greatly improved and a great deal of interest shown by all these counties. In many cases roads only 15 feet wide have been widened to 30 feet, and I expect within the next six months those roads will be in such shape that most of them can be put under maintenance. The proposition is entirely a novel one and the work is being done entirely by counties; no money is being spent by the United States whatever, the government simply furnishing an engineer. In this way we hope to demonstrate that it is better to keep a road up than to let it go to pieces and try to re-build it at large expense. The problem of maintenance we are just beginning to realize is as important as that of construction, and that as soon as a road is finished, it ought to be put under maintenance. I thank you for your attention.

THE CHAIRMAN: That concludes the program for the afternoon. The meeting stands adjourned until 10 o'clock tomorrow morning.

GEORGIA DAY

November 15, 10 A.M.

MR. W. TOM WINN IN THE CHAIR

THE CHAIRMAN: Ladies and Gentlemen, the meeting will now come to order. We are going to shift our program just a little, because one or two of our speakers have been detained and will come in later. I wish to introduce to you for the first address of the morning, Prof. R. D. Kneale, Associate Professor of Civil Engineering, Georgia School of Technology, who will speak to us on "The Educational Campaign for Road Improvement."

THE EDUCATIONAL CAMPAIGN FOR GOOD ROADS

PROF. R. D. KNEALE

Associate Professor of Engineering, Georgia School of Technology

The writer has chosen this subject because he believes it involves questions infinitely more important than those of type of pavement, or choice of machinery, or of organization, finance, or construction. He believes it involves the question of whether a large majority of our people shall take an abiding and an intelligent interest in our streets and highways, or whether that majority shall remain in indifference and ignorance. Approach one hundred men at random on our streets today and the consensus of opinion obtained from them would point to lameness, or inefficiency, or graft in the handling of public funds for road purposes. Rural opinion would only emphasize this verdict, for the sage-hen philosopher, who really crystallizes rural sentiment, is slow to appreciate, slow to praise. Sometimes the only cure for his native prejudice is to sell him an automobile. It is a condition that exists because of ignorance and indifference, and it is unjust and wrong. It prevents financing. It prevents construction. It prevents progress. It should be rectified. The writer hopes to emphasize a basic means for accomplishing this end.

This meeting is primarily an educational one. We meet here to learn and to teach, to know and to be known, to give and to receive inspiration. This is a clearing house of matters pertaining to highways. Atlanta invites you here to learn of her greatness and progress, and her hospitality. Upon adjournment the proceedings of this congress will doubtless be complete and any one of us sufficiently interested may secure a copy. We are engaged in an educational campaign of mutual self-help. It is an educational meeting but we reach only those who are already interested in the good road movement. We relieve the above mentioned evil condition almost not at all. This is not a failure on our part. We are performing the

function for which we are organized. We are not attempting to reach many of the family of Mr. Common People.

Other road organizations are also filling their chosen field in this campaign of education. Chief among these is our Office of Public Roads, highly efficient, and certainly doing a splendid work. In the interest of national development and progress this organization should be allowed to rapidly broaden through Congressional appropriations commensurate with the paramount importance of good roads in national life. The large majority, however, of those reached by this office are already sufficiently interested to attend meetings, to inspect roads, or to at least send a stamp to Washington. The masses of our population are not interested, and their attention cannot well be forced by present methods. The States through their commissions are ably supplementing the work of the Office of Public Roads, and they are reaching about the same class of people. The press, in the advance ranks of civilizing influences, the National Highways Association, the American Automobile Association, and other organizations are doing a magnificent work, but they cannot cram the people with that for which there is no demand. They are meeting the growing demand for knowledge, and they are forcing that growth to some extent, but of necessity they fail to reach the large mass of indifferent and ignorant to whom I refer.

Road education is crammed into a few by those who desire to sell road machinery and materials, or by real estate development companies, technical colleges are reaching a few, but the mass not reached by any of the above agencies is large. It numbers a great majority of our hundred millions, and under the present method of attack the diminution of that majority, though increasing, is yet too slow for so great a cause. The reduction of that majority should be hastened by striking at its very roots through the public school system.

There are over twenty-five million children of school age in the United States, and some twenty million of these are in school an average of ninety days per school year. Thirty-four per cent of these children are above the fifth grade, and their minds are keenly susceptible to impressions that will last through life. The social, the financial, and the political phases of the road question can readily be made to touch their lives at many points with living interest. No pressure will be required to keep that interest alive, only a hand guided by a reasonable intelligence. If pressure is needed it will be to bring their attention back to the dry bones of the three R's. The children will take their new interests into the home to arouse a parent who can be reached in no other way. If the danger of loosely spending easy money lies in bond issues, the child can grasp the idea. If the advantage of a good road can be had only through paying for it on the bond issue instalment plan, he can also understand that. The consolidation of rural schools requires good roads and forces good roads, and the child easily sees the all round advan-

tage and becomes an ardent advocate. In fact the child can grasp to some extent each social, financial, and political phase of the road question, and the community interest in a common good will make him a better citizen. His grasp will develop and broaden with years until he takes over the reins of finance and government. Then there should be no lack of progress through ignorance, and the public will exercise so highly intelligent a supervision as to preclude the possibility of misuse of public money. What an opportunity to strike at the roots of ignorance at the rate of twenty million a year!

It may be urged that the average rural teacher is too immature, or that she lacks the training to handle so great a subject. She was not too immature to learn and to teach something of physiology and hygiene. She is not considered too poor an instrument to advance the cause of scientific agriculture. Surely a person can grasp something of the social advantages of good roads as readily as he can the physiological function of a human organ, or nitrification of legumes through bacterial inoculation. Besides, the ability of rural teachers will increase materially with the consolidation of schools.

To initiate this educational movement, requires no new organizations, and but little change in existing ones. The Office of Public Roads already has corps of expert lecturers and demonstrators, who are campaigning among the nation's adults. There they are forced to overcome the inertia of long fixed habits of thinking before they can plant seeds of interest and enthusiasm for good highways. They are also forced to overcome a certain prejudice against outside influence in local affairs. This same lecture corps could reach meetings of educators in institutes, and in city, State, and national teachers' organizations. Bulletins published by the Office of Public Roads could be re-edited to meet school requirements, and could be used as free text books for talks, round-table discussions, and inspection trips. Bulletins could be arranged also for the vocational courses in high schools.

We who are attending this congress want good roads. We have a certain appreciation of their value or we wouldn't be here. We desire to enhance the value of our city lot. We desire to reduce the loss between producer and consumer. We want jobs. We want to sell equipment. We want to develop our community, our city, our State. We want national development. First, last and always we are for road progress, yet progress is slow unless backed by an intelligent and an interested public opinion. There is no great difficulty in constructing a highway if the public is sufficiently interested to finance it. If the money is raised it will be expended by willing hands. If there is inefficiency in the use of the money, that evil will be reduced and eliminated with the increase of public intelligence and interest. We are now educating a number of adults, but the number is all too small for so great a cause, and we are almost

entirely ignoring the class easiest to reach, easiest to influence, and many millions strong. Their stronghold is in the public schools. Shall we storm that stronghold, or shall we continue to expend all our energy upon the mature prejudice of the adult? A panacea for many road ills lies with the public school.

THE CHAIRMAN: "Convict Labor as a Factor in Road Construction." Judge T. E. Patterson, of the Prison Commission of Georgia, will open the discussion on this subject.

MR. BLAIR: Just one word. I don't think that a paper of the kind we have just heard ought to be passed without a word of special recognition. What the Professor has said with reference to supplementing the work of education in this country along the lines of which he speaks—behind that he has, with hidden modesty, failed to say one word that ought to be said in favor of the technical and engineering schools of this country, which are doing the very work, so far as they can, that he speaks of. I think that acknowledgment ought to be made publicly, because the moral force that is being exerted by the technical schools in this country, cultivating the very sentiments, honesty and integrity among their students, ought to receive attention. They are doing a great work in this country and I am glad to give attestation to that fact.

PROFESSOR KNEALE: I neglected to say something of the work of that kind. I have been in it for some time. Up in Montana we carried on college extension work through the University of Montana, and I did considerable of that work and also the State Highway Commissioner, but we failed to reach public schools. I intended to mention the work the colleges and universities are doing in that line, but so far I believe the technical schools have failed to a large extent to reach the public schools, the high schools, the people who come together in road meetings.

THE CHAIRMAN: I am much obliged to Mr. Blair for impressing that thought upon us. We will now hear from Judge Patterson.

JUDGE PATTERSON: This subject was intended to be opened by a paper from General Clifford L. Anderson, on "Convict Labor as a Factor in Road Construction," and the discussion of that paper opened by Chairman R. E. Davidson, of the Prison Commission of Georgia. In the absence of General Anderson, who has been ill for some days, and of Mr. Davidson, I will endeavor to outline what Georgia is trying to do along this line. Georgia commenced this work 30 years ago to a limited extent; about 20 years ago, to a larger extent, and about six years ago, all the convicts were taken from the lessees who had been working them in lumber, turpentine and mining camps, brick making, etc., and all the able-bodied ones were put upon the public roads of Georgia. We have been engaged

all over the State since that time in constructing public roads by the use of convict labor. The material progress that Georgia has made within these past six years in the construction of public roads, is the highest testimonial that can be made for the system that is now employed. There are more than 120 counties in Georgia using their pro rata of the State convicts upon the public roads. There is hardly a county in Georgia that has not got a network of public roads that an automobile or even a Ford could be run upon at a rate of 20 to 30 miles per hour, without danger, and that progress has been made very largely in the last six years. Six years ago that condition did not obtain all over Georgia. There were certain counties in which the roads were fairly good, but in the large majority of the counties you could possibly travel over them to some extent in buggies and wagons, but it was hard to get automobiles over them. The first tours that were made, certain counties ahead of them had to do some patchwork on the roads so they could go over them. Now, you can go in any direction and find perfect highways all over the State, and that condition exists through the use of convicts. In discussing this convict question, you have to consider its effect on the convict as well as the value of his work to the community. Modern study in penalogy, or criminology, is based on the principle that confinement in chain gangs or penitentiaries is not altogether for the purpose of punishment, for the purpose of deterring others from committing crime, but to reform the criminal himself, if possible. Road work I think does that to a greater extent than any system of convict management known to man, and I think that it is based on the principle that when the convict is worked within an enclosure or under a lessee, he feels that no one is deriving any benefit from his work except private gain and that the only object in putting him in there is to punish him for his crime. You can go and preach to him and tell him he ought to be a better man and he will listen to you, but all the time he will have that feeling, "If you are interested in me, why don't you make some other provision for me? Why do you want to keep me here and crush me." The result is that all over the world there is what is known as a criminal class. They get into prison, they get out, and after they get out they commit some other crime and get back. It is the same old grind over and over, until we have built up what we refer to as the criminal class. We have the same condition in our cities; you can go to a police court in Atlanta or Macon, Savannah, Columbus, or any city in Georgia, or any city in the United States, and the police judge will tell you, as man after man will come up before him, or woman after woman, how many times many of those prisoners have been there before. He sends them to the stockade, they serve their time and are released, but it does no good; they go right back. It was formerly that way in the penitentiary system of Georgia. I daresay, under this system in the last six years, the men who have been convicted and sent to the penitentiary in Georgia and served

out their time—not 15 per cent of them have ever returned to the penitentiary. I think it is on account of three facts: one is that they see that the public is getting some benefit from their enforced labor; some individual is not getting it all, they see that when they get out, they themselves are going to get some benefit from it as a member of the community. They may not reason that out just like I am stating it, but it is instinctive in the human heart that whenever a man works he wants to have something coming to himself from the work he does; that is characteristic of humanity, and you appeal to that feeling in a man, and from that you build character. Another thing, they are worked in the open; the finest moral qualities instilled in anybody are from being worked in the open, in the sunshine and free air, and next to the soil. I think you will find that a large majority of the leaders of the world's thought, the leaders in commerce, in banking and in all branches of human endeavor—come from the farm. It is because the boys on the farm are raised in the open, next to the soil; they acquire from that condition surrounding them those moral qualities that make good citizens and make leaders in thought and in action. The same thing applies to a convict; he is worked out in the open air, he is worked in the sunshine; he gets that moral stamina in him that aids him when he gets out, to make a man. In some States, Colorado is one of them, they select certain convicts for road work. Some of the most desperate ones they don't work there. They keep them confined. In Georgia we keep all of them on the public roads on the theory that all men have the same intuitive instincts. If you can give him a basis on which to build, there is hope for any man, and if you give them all the same treatment, you have a chance to redeem them all. So much for the convict road work as a moral force. It is an economical force because the community is necessarily compelled to support these fellows anyway, wherever you put them. If you put them on your roads, the community gets a benefit that is commensurate with the outlay of money for their support. It is not necessary for me to describe the benefit of good roads to a community; your being here at this convention is a testimonial to the fact that you know that good roads build up a community and add to its prosperity, its social advantages, its uplift in every way. You understand those things better, probably, than I could tell you. Pardon me for referring to the Georgia laws in this connection. The one weakness of the Georgia system is the lack of in working their roads, the lack of coöperation. We have just begun by putting in a State highway engineer, Professor Stanley, of Athens. The law provides that we may employ four, and we intend to do so if the legislature will ever provide funds. That is what we are working for now. Our idea is, that if we have this corps of highway engineers to visit counties, and show the men in charge, the county commissioners and the wardens and superintendents in charge of the road working force, what can be done with the convicts they have

and with the material they have, we will be doing great things for them. I was very much impressed this morning by Mr. Adams' talk, the Commissioner from Polk County. We wrote to all the county commissioners of the State when we started to put in this system of supervisors and Mr. Adams was one of the number that did not think it would work, but this morning he got up and admitted that he had been visited by a professor of engineering from the State University for a short time and he didn't stay long enough. Just a short visit has converted him to the fact that engineers are almost indispensable. Then our idea is to divide the State into four districts, put an engineer in each district, and have an annual institute in each district, where all the wardens superintendents and road commissioners can get together and discuss with these four engineers, all the problems with which they have to deal. This, to my mind, would be a long step forward. There is a movement on foot to establish a system of State highways, not from Atlanta to Savannah, but to go into all Georgia and build public roads between the main towns, the county seats; these roads to be built and maintained by the State. The county could take care of the county roads, the laterals, and tributaries. We can do that without spending any more money than is being spent now; we can do it with the revenue the State already provides for this work. If the government ever furnishes any additional funds for building these roads, we can have a perfect system. It is right for the government to do it, they improve the rivers and what is a river except an artery of commerce? They improve the harbors at the mouths of the river. Why? To give greater facilities for commerce; if they can improve rivers to aid commerce, why can't they improve a public road to aid commerce? One is just as much an artery of commerce as the other; in fact the road is more an artery of commerce than the river; there's ten times the commerce goes over every road in Georgia as goes over any of these insignificant rivers that the government spends thousands and thousands of dollars upon. The government is bound to assist and with the assistance we get from the government and the taxes now distributed to the various counties from the automobiles, we will have the funds to maintain these gangs and Georgia will have the finest system of public roads in the United States. It is a great thing we are undertaking, but we are going to make plans to get the necessary legislation when our legislature meets next summer.

THE CHAIRMAN: Before calling upon Governor-elect Harris I should like to know whether anyone wants to discuss this very important subject, or ask Judge Patterson any questions. I am sure that his position on the Prison Commission and his contact with convict life in Georgia, well fit him to give any information or to answer any question that might be asked. Many of you have visited our convict camps, and have no doubt learned a great deal about our system.

A MEMBER: I think Mr. Patterson has so ably discussed the problem that there are no questions to be asked, sir.

THE CHAIRMAN: If there are no questions to be asked, I have the great honor and pleasure of presenting to you Judge Nat E. Harris, Governor-elect, to whom we have assigned no subject, but have given the entire right-of-way for just as long a time as he likes, because if you have ever heard him speak once, you will know that you don't have to put a limit on him and that you will stay until he gets through. Judge Harris.

JUDGE HARRIS: *Mr. Chairman, Gentlemen of the Good Roads Congress, Fellow Citizens:* That was a very nice introduction of the Chairman for which I thank him. It put a good deal of responsibility on me too. The truth is, I did not know I was expected to speak in this gathering until a day or so ago when I saw the program. I had written to my friends here that I could not promise to attempt to make an address, but stated that I would like to come up and look into your faces and hear somebody talk on a subject I knew was of great interest just now, so I might find out what it meant, what it was and how far it reached, what was involved in it and especially what you knew about it. This was the idea with which I came to this convention.

Now, I heard one of your speakers refer just now to Judge Patterson's familiarity with the convicts of the State. I used to be on the bench myself and sent a good many people to the chain gang who are working on the roads of Georgia today, making good roads for us. During the past summer, if you will permit me, when I was going over the State in the canvass for governor—by the way one of the hottest canvasses we ever had in Georgia, I reckon, for the thermometer rose to 116 in the automobile in which I traveled on one occasion, and the boys frequently asked me in the court house, with the thermometer at 106, if they might take off their coats when I began to speak; of course you know I told them to take off their coats and keep them off till the day of the election for me—I say, as I went along one day I passed a chain gang that was working on the public roads, when one man, wearing stripes, stepped out a little from the rest of the gang and said, "Judge Harris, I'm representing you here"! I found out on enquiry that he was a convict I had sentenced while on the bench, so I want this Road Congress to understand that I too have some right to talk on the subject of road building, that there are doubtless many able bodied workers in the chain gangs, sent thereby myself who are doing good work for Georgia, and laboring to make good roads for her people, for the farmers and merchants and the doctors and lawyers, that their business may be worth more in the State to them and to the people who depend upon them!

I came to this State about fifty years ago; I started out from a

little place up yonder in East Tennessee, called Jonesboro, the oldest town in the State. I traveled down along the slopes of the Blue Ridge and entered Georgia first in Rabun County, then came on through the mountain district, riding a kicking mule on the way, while my brother drove a wagon, with sure-footed mules too. Looking back over these fifty years, I remember how the trail from Tennessee ran then along the sides of the mountain, over the ridges and the valleys—nothing but a trail. The inhabitants said I'd reach the Old Federal Road after awhile. Well, I did and it was a road, no doubt, but it was a road you wanted to get out of as quick as you could. Wherever there was a fork in it and you took one fork and went a little distance you were sorry you had not taken the other. We often turned out into the fields to avoid the road, because one could get along there better than in the road. When I reached Georgia and looked back over the trail I had followed, I said to myself, "I will write a book and call it, 'Short Cuts on a Journey to Georgia,'" and that is what it was, for I was all the time trying to avoid the windings of the trail and get down here. That was fifty years ago; I went back over that country in the last three or four months—I came down over the same mountain cliffs and hills and valleys, but I saw they had laid out turnpikes where the old roads ran. I traveled in an automobile, moving from place to place with a rapidity that would have made our ancestors turn almost crazy and feel that some sort of magic had been at work in the world. It was easy traveling; the rocks had been blasted out of the roadway; the grades all laid out well, and I said to myself, "How has all this been brought about?" I see a man in the audience who could answer this question. He has furnished plan after plan and survey after survey to these counties through which I traveled, and their nice turnpikes and level roadways will stand the storm for many a day.

Some one writing on roads, said, "The degree of civilization in a country may be ascertained by finding out the state of its public roads." Is that so? If it is, I am ready to say to you here, in a representative capacity, in a private capacity, or in any other capacity, that Georgia is not afraid to show hands with most of you—that we have started in this State a pretty good system of roads and we hope to go forward until we even take the front. We have aroused competition among the counties.

Way back yonder in the past, you know, there were two ways followed in road working. The first was, where the county compelled by law, had four days' work done upon the roads each year—by summoning the citizens along the road to do the work, or in lieu thereof levied a small commutation tax, that was never collected or if collected, rarely applied: the second system existed where the county could keep a chain gang and supplemented the intermittent road hands with a force that worked all the year round. In the course of time the legislature gave us the three alternative road

laws, which was an advance on the former times. Now we have gone still higher in the scale, and the State and counties have all put their chain gangs to work exclusively on the public roads, and a system of improvement has been inaugurated that will really count in the future, and promises soon to justify our people in claiming that this great old State shall no longer stand behind her sisters when you come to estimate her civilization by the splendor of her public roads.

But there are two views taken of the progress in road building. A good old lady who lives down in the center of the State, whose memory goes back to the old system, said to a friend lately: "I don't believe in these new scrapers and automobiles for our public roads; all they need is the pine top and the hoe; that was what the people used in the old days. We land owners have to pay for these new things and in this way the folks that travel get the advantage of us." The old lady is not alone in her views; there are many who feel just as she does, so it will be necessary to educate the people till they realize the true value of the reform that is going on. There are not wanting those who will complain at the slightest increase of taxes, consequently it is the more important that the people generally should understand how the building of the roads, by adding values to real estate and its products, gives the owners in return, something with which to pay the increased taxes. And the whole county shares in the benefits. Why, a farmer now in the counties where the good roads policy is followed, enjoys all the advantages of country and city combined. His automobile carries him from the farm to the city and from the city to the farm with incredible ease, while his telephone brings him into direct communication with the great centers of trade as well as with his own neighbors and friends round about.

This competition among the counties, to which I referred just now, is destined to play an important part in our good roads movement. The smaller counties may well say to the counties with great cities, "You can put your money in fine public buildings and parks and streets, but we will put ours in our roadways, and make them better than your streets so that—bringing our produce to market easily—our farms shall increase in value as your own real estate ascends in the same scale." And this idea is getting more familiar every day. I used "to ride the circuit," as we lawyers call it—going around the counties adjacent to Bibb, where I live, to attend the courts and keep up with the business of my clients, traveling in a buggy or on horseback. In those days Bibb County, in which the city of Macon is located, worked her chain gang on the public roads. I could tell the exact point where I would cross the line into the other counties, for the Bibb roads were far better than those in the adjacent territory. Now, this is all changed. The small counties are beating Bibb, for they have chain gangs and improved road working too; you can tell now for instance, where you cross the line

into Twiggs, because Twiggs has better roads than Bibb. And the challenge is out to Bibb, "You may beat us in your buildings but we'll beat you in our roads." And so it is, through the State.

I am proud of the way in which we are going forward in Georgia, and I greet you all today in her name. I am glad to be a part of this Congress, to look in your faces and tell you that this old Empire State, is awakening on this great question, that her people will join you in the crusade, or better, the evangel in favor of good roads, and try to bring the whole country to understand and appreciate the importance of the subject.

And now, my friends, I want to say a few words, of a general nature, on the advantages of good roads to the community. These are so obvious, and this Congress has been urging them so often, that I suppose it is almost a work of superrogation to go over them again. But there are a good many Georgians in this audience, and I have thought it might not be out of place to repeat the argument in their presence. The truth is, the whole State needs good roads, and more roads, and better roads, everywhere. There is no end to such improvements. If the seaboard is to be brought to the mountains, or the mountains to the seaboard, this is the way to do it. There is that great country lying below us, known as the "Wire Grass,"—I love to talk of it now, because it was once under the ban—nothing but a vast pine barren. I have just had the opportunity of traveling over it, and can appreciate its coming strength and greatness. It is a region of magnificent possibilities.

Mr. Chairman and Gentlemen of the Congress, if you will only give that "Wire Grass" country good roads and reasonable railroad facilities, you will soon see an Empire developed in this Empire State, such as you never conceived or thought of, in all your life! All that is needed to insure the speedy settling up of those vast level areas of farming lands is to give the people good roads, so that more inhabitants may come in, take up the lands, utilize their unparalleled productiveness, and make the country worth all that it ought to be to Georgia.

It is rushing forward with wonderful strides every day, and this good roads gospel is taking it by storm, as it seems to be taking the State, the South, yea, even the whole Nation. But to restate the argument:

First: A good road enhances the value of the lands adjacent to it. This is an A B C doctrine. While the tax may be increased, the owner is afforded means the more easily to make the money, so that he does not feel the burden.

Second: The facility for travel and transportation enables the citizens along the road to live with greater ease and more comfort, to transact business with more convenience, and with the automobile, and telephone, makes space and time of far less consequence in the affairs of life.

Third: The good road tends to promote intelligence, for it en-

ables the children to reach the school house, with greater convenience, so as to secure the advantages of early training and education. Rough roads are sometimes a barrier to knowledge.

Fourth: The good road promotes both social and religious association. Visiting is made easier, and people of the community, or even of the State, are made better acquainted, and see more of each other.

My countrymen, I have noticed that the misunderstanding in communities, the troubles that spring up and beget endless sufferings among our people, would nearly all be prevented if the people only knew each other better. This is so, North, South, East and West—it is so, locally, it is so generally, it is so everywhere. If the people at large are given the facilities for travel and transportation they will come together oftener, learn to know each other better, and harmony will reign where discord now prevails.

Fifth: The good roads will tend to preserve the health of the community. You can provide the remedies for sickness with greater ease, in the country. I heard a gentleman say not long ago, that since they had opened the turnpike road by his house he could call a doctor from town and get him to the place in an emergency within 15 or 20 minutes, though he lived three or four miles away from the place.

Sixth and last: Good roads increase the population of the country. The more good roads we have the more people there will be to travel them. Oh! we have room enough here for any ordinary increase in our population. We do not object to the coming in of good settlers. We have lands enough in Georgia to house and feed our own people with their natural increase for one hundred and fifty years to come! So we can afford to divide with others, for none of us will live that long.

When people from a distance come to see us, find out what we have here, and learn that we have the best public roads in the country, see how easy it is to go from place to place—why, they'll know that we are up to date, and will fall in love with our good, old honest ways, and stay with us!

There is sometimes a humorous side to our road working. While I was on the bench a mandamus proceeding was brought before me, alleging that the commissioners of one of the counties of the circuit were not working one of the main thoroughfares running by the homes of the petitioners. It was alleged that they had worked all the roads of the county except the one in question; and this they had worked to within about three miles of the county line and then stopped. It seemed that just across the county line there was a thriving little town which was a rival of the county site, bidding very vigorously for the trade and business of the citizens round about. So the commissioners, standing up for their home town, let the road to the county line go without working till it became almost impassable, while the road to the county site was kept in splendid condition.

This was good political protection, you know, but the cold law would not stand for it. Competition in business and equality in transportation are the favorites of our statutes. Nevertheless, it was a practical demonstration of the fact that a good road counts for something in the community.

And now I think I have about covered what I wanted to say to this Congress. My recent travel over Georgia has at least given me some experience with the good road situation in the State. I recall the fact that several times when I hired an automobile at one county site to go to another, if the road in the first county was rough and difficult, and after crossing the line, got better, and smoother for travel, the automobile driver would apologize for his county, and say, "We can't get our commissioners to take the right view of matters, but we have hopes at the next election to show them a few things."

So, the demand for good roads is growing, for the people are finding out that a load of produce, of cotton, or corn, or any farm product, is nearly three times as large on a good, modern, well graded turnpike as it was on the rough highways of the past. And the county authorities are realizing that it will not do to be left behind in the progress of the times on this subject.

And now, my friends, I repeat that I am proud, as the next executive of this State, to come before this Congress and speak to you. If you need the countenance and help of the next administration, I assure you that you already have the chief, and I think you may count on the assistance of the legislature to do whatever is necessary to bring the subject before the people in the most effective light. Show us what is needed and we will try to put our shoulders to the wheel so as to push this old Empire State forward, until her name shall ring out among the people of the North and the East and the West, as the one State of the South that has the finest laid out public roads in the Union. It would be a distinguished honor to preside over a State that could safely point to her roadways, as the index of the highest civilization of the world!

THE CHAIRMAN: We appreciate very much the kindness of Governor Harris in coming to our meeting this morning and adding his presence to this occasion. The next speaker, as you will see on the program, gentlemen, is Prof. Charles M. Strahan, Dean of Engineering, University of Georgia, who will speak on the subject "Why Georgia Builds Top Soil and Sand-Clay Roads."

WHY GEORGIA BUILDS TOP SOIL AND SAND-CLAY ROADS

C. M. STRAHAN, D.Sc., M.A.S.C.E.
Dean of Engineering, University of Georgia

The counties of Georgia during the past six years have directed the bulk of their road building energy to the construction of soil roads of various kinds. They have recognized that any road worthy the name must have a reasonably strong, smooth, and durable wearing surface. They have secured satisfactory surfaces by the use of selected top soils, of semi-gravel, of sub-strata of sand-clay encountered in grading; and from artificial mixtures effected by claying deep sand road beds and by incorporating sand in sticky clay road beds. Some 12,000 miles of improved roads have been built and much of this mileage has been surfaced with one or more of the above materials.

There are four principal reasons why the energy of Georgia has gone into this type of construction: the first is an economic reason; the second is a psychologic reason; the third is a geologic reason; and the fourth is a scientific reason.

First: In round numbers, Georgia, with $1,000,000,000 of tax values and 147 counties, is credited with 84,000 miles of road. Exclusive of the 7 chief city counties, the average county shows approximately $6,000,000 of tax values and 600 miles of public highways.

These basic financial facts have compelled the counties of Georgia to carefully consider their financial policies. The outcome has been that while highly desirous of good roads, the justifiable basis of expenditures has been forced below $1000 per mile. Hence they have turned to the local soils, intelligently selected and used, as the first step and only possible step toward extensive highway betterment within that average expenditure. They have recognized that the elements of cost for a road program are: (1) expert supervision, (2) preparation of the road material for use, (3) haulage cost, itself dependent on tonnage, average length of haul, and ease of loading and unloading, (4) cost of spreading, (5) cost of consolidation and shaping, and (6) the cost of maintenance. In all of these items, they have felt that the local soils with short hauls, needing no crushing or mixing, handled by simple tools and moderate cost machinery, easily loaded and distributed, consolidated by the road's own traffic, and all done chiefly by unskilled labor, presented the minimum outlay for equipment, labor, and all other construction costs. Nor have they been disappointed. Total costs as reported from various counties range from $300 to $600 per mile according to the particular material, the width of wheelway, and the length of average haul. They contrast the resulting roads with broken stone roads at from $5000 to $8000 per mile and figure that the interest on the latter investment would annually build a mile of good soil road. They

compare the maintenance figures of $10 to $50 per mile with the $100 per mile credited to macadam roads and place at 15 years the life of each type. They find the traffic of all kinds pleased and contented, and see no undue injury wrought by the automobile. They feel that the betterment is real and durable, and that this type of road, free always from deep mud or deep sand, has at least met and conquered the two arch enemies of highway transportation.

Second: The psychologic reason is also a reason of practical politics. It consists in the fact that taxpayers, particularly the rural taxpayer, become rapidly restive unless the rate of road building and the consequent spread of the benefits of the road expenditure is reasonably rapid. The soil roads are built very quickly. Counties report from 20 to 60 miles annually. In five years, a great change is wrought in the traffic conditions of any county. The restive citizen may be gracefully bidden to wait; and his powers of revolution are inversely as the annual growth of improved mileage. There is thus a better chance for continuous county road management.

Third: The geologic reason rests upon the vast areas of underlying siliceous metamorphic rock in North Georgia, upon the gravel soils that abound along the edge of the Coastal Plain in Middle Georgia, and from the sand-clay strata which underlie so many of the counties of the Coastal Plain itself. Many of the resulting clay soils of North Georgia are abundantly charged with coarse sand and decomposed rock, and are of admirable road value. Intelligent search has revealed them in wide distribution and of exceptional wearing qualities. Gravelly soils and sand clay top soils are likewise found in many counties along the Fall Line that traverses the State from Columbus to Augusta. In the Coastal Plain counties, outcroppings of gravel are occasional, outcroppings of clay hills are quite frequent, and sub-strata of so-called clay, in reality a natural mixture of clay and sand, is widely found at short depths below the surface ready to be excavated and placed on the prevailing sand bed roads of that section. In some of the swamps of South Georgia the muck contains fine clay and is utilized as road covering.

The writer has been struck by the prevalence of suitable road soils in every county visited and is convinced that systematic surveys for the location of such soils adjacent to the highways would be amply justified in every county by the discoveries made.

This thought is commended strongly to the representatives of the Fourth American Road Congress. Few States in the Union can afford to ignore the substantial economies that accrue from the use of good local road soils, on at least a part of their highway systems.

Fourth: The scientific reason why Georgia is building top soil and sand-clay roads rests on the fact that by careful examination in field and laboratory, enough is now known of the composition, road behavior, and method of consolidating of these road soils to select them intelligently in advance of construction and to feel confident of the results. The School of Civil Engineering of the

University of Georgia, through its road laboratory and field officers, since 1908, has been privileged to work jointly with many county road officials in the study and use of these materials. It has been called upon to select and advise concerning suitable soils in advance of construction and has watched the roads after construction. Much data has been accumulated and digested, many partial and complete mechanical analyses have been made. The limits of this address does not permit detailed entry into laboratory methods, but the following short table of typical soils selected from roads of known efficiency in north, middle and south Georgia will serve to indicate the character of separations made:

TYPICAL GEORGIA ROAD SOILS

BY PROF. S. B. SLACK

Analysis After Separation From Gravel

		Gravel	SAND					Silt	Clay
		Above	Diameters in Millimeters						
	North Georgia	1.85	1.85-.86	.86-.24	.24-.14	.14-.07	Total	.07-.01	.01-.00
476	.....	4.0	8.0	33.0	17.6	13.6	71.2	15.0	14.0
466	.....	13.0	19.6	44.6	8.0	6.0	78.2	4.5	15.0
150	.....	3.0	8.5	36.0	12.5	11.3	68.3	12.2	11.0
10	.....		7.8	34.3	9.2	9.0	60.3	12.8	25.0
	Middle Georgia								
	.....	0.8	0.8	30.1	15.4	20.0	66.3	14.1	18.0
108	.....		8.0	22.0	14.7	15.3	56.6	14.6	27.5
124	.....	10.4	2.8	81.3	18.4	25.0	54.5	12.4	31.0
424	.....	10.4	4.6	22.0	14.7	15.3	56.6	14.6	27.5
120	.....	10.0	4.	30.0	18.5	12.1	64.6	13.6	20.0
106	*South Georgia*								
	.....		2.4	9.2	19.7	27.0	58.3	12.8	25.0
434	.....		2.7	20.7	21.2	26.4	71.0	14.8	14.2
103	.....		2.0	32.0	20.8	17.4	72.2	13.4	14.0
113	*Special*								
470	Augusta Gravel.	15.2	28.0	54.4	6.0	2.2	90.6	3.4	6.7
116	Pipe Clay.....		14.3	16.9	4.8	4.7	40.7	8.8	50.0
	Sieve Numbers.....	10	20	60	100	200			

Unable to present in this article the specific road histories of these and many other samples studied, the conclusions tentatively reached by the laboratory may, however, be stated as follows:

First. The presence of from 60 to 80 per cent of total sand is necessary. The best soils show 45 to 55 per cent sand coarser than No. 60 sieve. The sand between No. 100 and No. 200 has little hardening value. See samples 150, 106, 10, 466, 476.

Second. Ten to 15 per cent of gravel above No. 10 sieve and smaller than 3 in. diameter is very effective in hardening. See samples 150, 10, 106, 466, 120.

Third. When the sand above No. 60 is less than 40 per cent the resulting surface is notably softer than with coarser sand.

Fourth. True clay in excess of 30 per cent gives a soft road with mud.

Fifth. The best clay percentages lie between 10 and 20 per cent.

Sixth. A highly colloidal clay in low percentages probably gives equal bond with a less colloidal clay in larger percentages.

Seventh. The non-plastic silt aids in reducing expansion of the true clay.

Eighth. Soils with all fine sand need higher percents of clay; but are not so hard in dry weather and wash readily in heavy rains. They require frequent resurfacing with road drags.

Ninth. All of the typical road soils in the table have shown ample betterment over the roads they replaced to justify the expense of construction.

The laboratory has reached a conception of the way these soil mixtures act which may be of service to those interested.

While the resulting surfaces are of varying efficiency, the better grades, usually carrying coarse sand and gravel, give surfaces too hard to cut with the heaviest road machines, capable of supporting the heaviest loads after long rains, free from mud or excessive dust, and uninjured by automobile traffic in both wet and dry weather. The medium grades carrying medium sand and no gravel are firm and hard but can be cut by heavy road machines; they are somewhat softened in long rainy spells but do not cut deeply, and are somewhat more dusty in dry weather.

The soft grades carrying chiefly fine sand are firm and strong in dry weather, are subject to washing in heavy rains, and softening, and can be resurfaced with light metal or split log drags. They usually show a lack of proper balance between sand and clay and mark the lower limit of suitable road soils.

The successful soil must carry enough hard aggregate to interlock and support the traffic loads and to resist grinding and crushing action. This property is imparted chiefly by the sand and gravel content. The variations of these ingredients in amount and size affects most strongly the hardness and durability of the surface. It is known that sand beds when moist are relatively firm unless the sand is excessively fine, and supersaturated with water. Quicksand conditions are then developed. It is therefore probable that in wet weather the strength of the road depends primarily on the sand content, and that graded mixtures from coarse to fine are better than uniform grain or small sizes.

Through a nest of standard sieves No. 20, 60, 100 and 200, the sand is separated into four grades of fineness, and so reported in the analyses. The sizes above No. 100 are the effective body material. That below No. 100 has some value in reducing the total voids in the graded mixture.

Naturally the laboratory analyses pay particular attention to the quality, sizes, and total amount of the sand in the mixture. In the tables of analyses submitted herewith it is to be noted how large a percentage of total sand and of coarse sizes is found in the more successful soils. Moreover the item called "silt" is in reality mostly extremely fine sand.

The second important characteristic of a suitable road soil must be that it shall prove water resistant in wet weather and firmly bound and smooth in dry weather. Dependence for these properties is upon the clay elements and the silt.

The laboratory in its complete analyses separates and examines the quality of the true clay. It is to be noted how small an amount of true clay is found in the best grades—12 to 20 per cent. The contrast of clay contents in poor soils is shown in the sample of pipe clay included in the table with 50 per cent true clay. A further contrast in the other direction is seen in the analyses of the Augusta gravel with only 6.7 per cent of true clay. The bond of this gravel arises chiefly from its interlocking strength.

The laboratory defines "true" clay as that portion of the sample which remain in suspension after settling for 13 minutes through water 8 centimeters deep. It is removed by repeated washings, settling, and careful siphoning off. Most natural clays are impure and contain large percentages of coarser materials such as sand, mica, and silt. They vary greatly in plasticity and in the expansion and shrinkage under the action of water. The true clay contains an extremely fine portion called colloidal clay. The colloidal clay is very glutinous or gummy. The coarser clay has less gumminess. It is thought that the binding value of the clay depends to a notable extent on the amount of fine colloidal ingredients. In dry weather, this gives great adherence, but unfortunately in wet weather the colloidal matter softens quickly. It probably is one of the chief causes of the high expansion of the clay when wet. The argument would then be that a clay too rich in colloidal matter when used in a sand clay mixture is apt to soften too readily and by swelling tends to break the interlocking strength of the sand grain. The larger the total clay the greater the expansion. The desirable kind of clay would be that which has a rather low colloidal percentage to meet wet conditions but yet enough to bind firmly the sand grains in dry weather. It also appears desirable that the total real clay should be as low as possible consistent with adhesive strength in dry weather to avoid expansion effects. This also points to the value of a closely graded sand mixture with a minimum of voids and thus requiring a minimum of clay.

It is evident that the small percentages of clay in the best road soils is not enough to fill the usual 30 to 35 per cent voids that exist even in a well graded sand. But the silt material together with the true clay do furnish enough to fill these voids. The silt as separated in the laboratory analysis is itself largely composed of silica or sand which passes a No. 200 standard sieve, and other equally fine material of partly reduced soil minerals such as feldspar, mica, etc. It shows little plasticity or adhesive value unless iron salts are present, but is useful in filling voids. It may be said that the true clay, the silt, and, when needed, some of the fine sand

(between No. 100 and No. 200 sieves) really compose the "binder" which unites the coarser sand particles, and fills the voids. For ordinary cases of soil examination the separation of the binder from the coarser sand by washing and rapid decantation is sufficient to give a fair basis of judgment regarding its suitability for road building. The more complete analyses aid in forming a sound conception of just what goes on in the consolidation and road behavior of the material.

In all of these materials efficiency requires a uniform and intimate mixture of the sand and the binder.

The consolidation is effected by the construction teams and the regular traffic. A bed of the loose material 10 inches thick and 16 to 20 feet wide is deposited in one layer. The traffic gradually packs it. A period of wet weather is desirable for a green road as the wheels and hoofs then puddle and pack the mass from the bottom upward, aiding also the uniform mixing. During the consolidation process the surface is kept in shape by the frequent use of the road machine until the final surface with a crown of one-half inch per foot is firm and smooth. The semi-gravels are top soils carrying 10 to 15 per cent of hard quartz gravel. All material coarser than a No. 10 sieve is classed as gravel. Rocks above 3 inches in diameter are objectionable and should be removed while loading, or dressed to the bottom of the 10-inch soil layer as the work goes on. The gravel if hard and non-crushing is a distinct advantage to the road soil playing the part of the broken stone in a cement concrete mixture and giving it greater hardness and stronger supporting power in wet weather. But soft gravel of feldspar hardpan, or mica schist is undesirable. In some counties an iron-silica gravel mixed with the soil is found which gives admirable roads.

The packed top soil surface from the best soils is surprisingly hard and surprisingly water resistant. It requires a rock plow or a heavy macadam type of scraper drawn by a traction engine to break up the bed when once thoroughly packed. The laboratory has taken up solid blocks, 20 x 20 inches and 6 inches thick, after weeks of rainy weather, from these roads.

Although very dense, the blocks taken from the road are distinctly porous in character. Why then does not the rain saturate the bed and loosen the bond between the sand and clay? The following explanation is suggested: The rain soaks into the pores of the dry road, at first carrying fine particles of dust to seal up the capillary tubes and pores. The first moisture absorbed by the clay expands it and also tends to close the capillary tube and pores. Hence the further ingress of water is prevented, the main slab is not softened, and the only mud is a thin coat on top where the wheels have loosened the surface by grinding and slight cutting. When rain ceases the skim coat of softened material will pack and rebind with the slab below. Excess of clay in the mixture by swelling with water loosens the interlocking of the sand structure,

is too soft to withstand the cutting by the traffic, and permits water to work and puddle downward layer by layer until deep mud results. Excess sand works inversely. Not being sufficiently cemented in dry weather, the clay binder is broken, pulverized, and blown or washed away leaving a loose sand layer which finally becomes objectionable. The well-balanced sand and clay mixture avoids both of these weaknesses. The surface mud is thin and remains underlaid by firm material. Hence the traffic is supported. It does not stick to the wheels. Hence unlike the usual earth road, the top soil roads are not easily cut into deep holes by the constant churning and withdrawal of material by the wheels. Dry weather in fact is more like to break them down than rain—particularly if the sand clay ingredients are not uniformly mixed. A good crown is necessary to prevent long saturation by standing water.

It is a serious structural mistake to use too thin a layer of these surfacings. A depth of 6 inches loose packing to 4 inches on sand and loam road beds and 10 inches loose packing to 6 inches on clay road beds is essential. On fresh embankments and on rotten mica foundation a thickness of 12 to 14 inches loose will give adequate beam strength to offset the weakness of the water-soaked foundation.

The chief hurtful impurities encountered in road soils are mica and feldspar. Their presence is readily detected by examination of the separated sand contents. The feldspar either as gravel or sand is friable, easily crushed, and weathers rapidly into clay. Any large amount is distinctly destructive of good service by the soil. Mica in abundance is similarly undesirable above 2 or 3 per cent. The flat scales destroy the interlocking value of the sand and furnish slippery surfaces along which water penetrates and rapid softening ensues.

The influence of organic matter is distinctly helpful in binding these soils, but is rapidly lost by decay and weather action.

The writer believes that the possibilities of road surfaces made from natural soils are far greater than is now realized.

More careful attention to the exact mixtures, intimate stirring and mixing, the use of sprinklers to secure proper moisture, and finally the positive consolidation of a definite thickness by the use of tamping rollers, while possibly nearing the cost to $1200 per mile, could result in surfaces permanently serviceable to the heaviest rural traffic.

Moreover, where the expenditures for rock covered roads are now nearing from $5000 to $10,000 per mile, the $1200 soil road would leave ample funds for constant road policing and immediate repair, thus solving that really unsolved yet vital road problem, to wit, proper maintenance.

THE CHAIRMAN: Is there anyone who wishes to discuss briefly any of the points in Professor Strahan's paper? If not, we are going to adjourn the meeting. Governor Harris is anxious to go

through the exhibits and no doubt there are quite a few of our Georgia commissioners present this morning, who just arrived in the city last night and this morning and are also anxious to visit the exhibits. We will adjourn the meeting until 2 o'clock this afternoon.

Friday Afternoon, November 12, 2 P.M.

W. TOM WINN, PRESIDING

The principal address at this session was an illustrated lecture by Dr. S. W. McCallie, State Geologist of Georgia, on the "Road Material of Georgia." In order to secure proper equipment, this lecture was delivered in the moving picture room.

At the conclusion of Dr. McCallie's lecture, President Fletcher, in a few well chosen remarks, expressed his great pleasure at the unqualified success of the Congress, and thanked the officers for the valuable assistance which they had given him.

No further business appearing, President Fletcher declared the Congress adjourned sine die.

WOMEN'S CONFERENCE ON ROADS

Ansley Hotel, November 10, 10 A.M.

Under auspices of the Woman's Department of the American Highway Association.

Mrs. Robert Baker in the Chair.

THE CHAIRMAN: The Conference will please come to order. It is very fitting that this new movement among women should be launched in the State which first offered to American women the equipment by which to make herself useful in civic life. Georgia's example has been followed until now there is a great army of highly educated and intelligent women eager to help their brothers make this country a model for all the world. No activity in which they can engage will have a more beneficent and far reaching effect than this, to remove the check upon our social development and our material prosperity caused by our disgraceful roads.

Great oaks from little acorns grow! It is with the hope, with the *assurance*, of great things to come, that I greet you here today and introduce to you as the first speaker at the first women's conference on roads, the wife of your governor, Mrs. John M. Slaton.

MRS. SLATON: *Ladies of the Good Roads Congress:* I am glad to welcome you to a State that has exalted woman by establishing the first female college in the world—in Macon, Georgia. The devotion of our splendid men speedily expressed itself by affording a widened horizon through the instrumentality of education, and with this greater power is imposed the greater responsibility of service.

Our sex is being called upon to a greater extent than ever before to aid in the practical activities of life, and especially in those which affect the home. Feminine sympathy is ever alert when the happiness of the fireside and the interest of childhood are involved. A large proportion of our citizens live in the country, and accessibility to church and school house, the receipt of daily mail, the extension of the limits in which local papers can be circulated on the day of publication, the use of parcels post, are dependent upon our highways and necessarily affect the happiness and welfare of our sex.

Good roads mean more land cultivated, and more profitable crops, and a decrease in the cost of hauling them to market.

The purpose of the Woman's Department of the American Highway Association is to create through the educational work of women, a demand for an efficient State Highway Department, and also for the constant and adequate maintenance of roads built with the public money.

A wise administration lowers the cost of materials since they are bought in the largest quantities. It prevents the unnecessary

duplication of road machinery—it reduces the number of road officials. For instance, under the administration which generally prevails in the United States and which is based on the theory of extreme localization of authority in road management, there are nearly 140,000 road officials. The road laws in most places do not require of these men any technical knowledge of road construction or repair. Reforms which would substitute a comparatively small body of trained men, giving all their time to road work, would save the country more than $50,000,000 every year.

A joint committee, composed of a special committee of the American Bar Association, a committee of the American Highway Association and a group of the foremost road engineers of the country are engaged in the compilation of a code of laws for the State administration of highways. When that code is published the Woman's Department will work in each State for such parts of the code as are applicable to climatic and other local conditions.

This code of laws will provide for a State engineer, his assistant engineers in charge of sections of the State, then county assistants in charge of the road supervisors, etc., section bosses and the necessary laborers. These men, from the highest to the lowest, should be appointed solely for their competency, and should be retained in office as long as their work is what it should be.

Good roads mean an increase in our rural population, and a consequent decrease in the crowding of our cities, and thus a lowering of the cost of living. More prompt and less expensive medical attention—far larger school and church attendance and above all new life for the farmers' wives and daughters.

Personally, and for the women of Georgia, I welcome you—our homes are open to you, and I trust that you will take with you on your return the memory of a sympathetic and kindly people who have been glad to have you as their guests.

THE CHAIRMAN: As at the Road Congress the men are welcomed by the Governor of the State and the Mayor of the city so are we welcomed by the women who represent the State and the city. Our second speaker is the President of the Atlanta Federation of Women's Clubs. She is the leader of 8000 energetic, altruistic women, all busy about many good things. I have the honor to introduce Mrs. Samuel Lumpkin.

WHAT ORGANIZATION MEANS TO WOMEN

MRS. LUMPKIN

President Atlanta City Federation of Women's Clubs

I am quite sure each and every one of us here understand the importance of federation and coöperation, the importance of cooperative effort and unity, not only among ourselves, but with men, in every undertaking that is worth while. We all understand that we

must work in unity and that no one individual can accomplish anything no matter how great their ability or efforts, unless they cooperate with others and make the effort worth while. I think we all understand that, and we all know that organization is the greatest thing of the present age for accomplishing things and I think in this civic evolution in which women are becoming more and more interested, it is not because of their wish to rule or show their authority over men, but simply because it is their aim and wish to be of *help*. And I think this meeting and all other meetings of women are simply for the purpose of coöperating with the men by forming organizations among themselves to aid the very best and to be of the most service and the most help to the men—we want to do things to help other persons, and I believe we are coming more and more into public life ourselves, because the world is so now that we must do it.

This Road Congress, I think, is a magnificent thing, especially for the country woman. We cannot say too much for the country woman. I know what she has to contend with and to suffer. For years, my husband was a circuit judge over a large number of small villages, and I myself have gone over all those country roads, and I know what it is to be in the country. Many times we had to go through creeks, without bridges, when I would have to draw my feet up on top of the seat. I *know* the hardships the country woman has to undergo.

We cannot say too much for the country woman—she has the dignity and sweetness and unselfishness, which is the most appealing thing in the world. We cannot say too much for good roads. We must all bow down in reverence to the country woman—therefore, everything that pertains to her comfort and health, we want to have a hand in accomplishing.

THE CHAIRMAN: Mrs. Logan Pitts of Calhoun, Georgia, Chairman of the Committee on Civics, Georgia Federation of Women's Clubs, will now tell us what the club women have already tried to do for the Georgia roads. Mrs. Pitts.

WHAT WOMEN ARE DOING FOR ROADS NOW

MRS. LOGAN PITTS

Chairman on Civics, Georgia Federation of Women's Clubs

"Good Roads"—this subject of good roads which we are here to discuss today, is one that is dear to my heart. Since this movement was endorsed by the General Federation of Women's Clubs about three years ago, the study of this subject is being engaged in by club women throughout the country. As Chairman of Civics for the Georgia Federated Clubs, it has been my policy to urge the importance of this need as being essential to the development of the best intelligence, happiness and prosperity of our people and the clubs through their civic committees and their county papers have done much in the promulgation of this principle of good roads,

The activity of the club women, the constant agitation of the subject by chambers of commerce, and other agencies, through the columns of leading magazines and the daily press have resulted in the creation of a public sentiment, favorable to the good roads movement.

When Mr. Roosevelt asked the people of rural America what would contribute most to their happiness, nine-tenths of their answers were, "Good Roads." Mr. Page says: A mighty wave of sentiment for good roads is sweeping over the entire country, and already the American people have entered upon a road building era which has no parallel in the history, not even the splendid era when Rome knit together with massive military roads the far fleeing outposts of her empire, nor the century of constructive work begun by Napoleon, which has given to France most superb systems of highways in the world.

Nearly all the States have established departments of highways and have provided for State participation in the building and care of the highways.

The rapid introduction of the automobile into every section of the country has revolutionized traffic conditions—it has brought people close together, the concentration of population in manufacturing and traffic centers has made necessary the transportation of immense quantities of food from the producer to the consumer and the transportation of immense quantities of manufactured products back to the farm dwellers from the city factories. The vacation-loving American has made possible the opening up of summer and winter resorts and has made accessible the splendid scenery of our country.

The cumulative results of all these individual forces has been the weaving of a web of interdependence which reaches every city, every town and every farm house. The public highway is no longer a mere local utility, it is a national asset, a national responsibility, and the Congress of the United States has come to a realization of this fact to such an extent that the day of Federal aid to road construction is at hand.

The need for good roads is apparent—the demand for them is becoming universal, the question now is, how are we to secure them and maintain them so as to give the most efficient service to all the people at the least possible cost.

This subject is being studied from a scientific and business-like standpoint for the first time in the history of the country. Let us hope that the deliberations of this Good Roads Congress may result in some plan for highway improvement that will meet with the approval not only of the State and Federal road officials, but also the people at large. The interest of our Georgia club women in this subject as I have said before, has been expressed, so far, mainly in the agitation of the subject with a view to arousing a public sentiment favorable to this movement, while our efforts have been directed principally to the elementary principles of civic

betterment. That clubs have outlived their period of amateur effort and are already taking a broader perspective of the work, was shown by their ready response when just one year ago it was announced that the department of civics had enlisted the interest of railroad officials in a coöperative scheme of promoting a State-wide improvement of station grounds and rights-of-way. Immediately, numbers of them took the matter up with their railroad officials, and already much has been done.

We believe the work accomplished at those places to be a forerunner of those larger achievements of civic betterment, which we await with faith and strivings, and which will include not only a State-wide improvement of station grounds, but also, a system of good roads, generous enough in its layout to provide for a scheme of beautification similar to that of the proposed Lincoln Highway, which is to be built from New York across the continent to San Francisco. Interest in this highway is general and has given impetus to the good roads movement throughout the country. Affiliations with the Lincoln Highway Commission is a Lincoln Way Tree Committee, composed largely of club women, which is working out a plan for its beautification and it has been proposed that each State adopt a distinct style of its own by planting trees, shrubs, and flowers that are indigenous to the State through which it passes. For instance—New Jersey will plant fruit trees for their bloom in the spring and their fruitage for travelers in the fall. Michigan women will plant a car load of walnuts. The women of Utah have a wonderfully interesting idea—the pines of their mountains, the tiger lily, their State flower, the roots of which provided nourishing and delicious food for their pioneers when all other food failed them, the cactus and the sage brush of their deserts and emblematic figures of salt where no vegetation will grow.

In California, the pepper tree will be used, and the children of Oakland have been gathering golden poppy seeds, and will sow them after the fall rains with the blue lupin to border them, so that motorists may drive through many miles of blue and gold bordered highways, when they attend the fair in San Francisco.

What a beautiful idea it would be for the children of all the States to assist in beautifying the highways.

Italy has her Appian way, England her magnificent roads with their famous hawthorn hedges, France her superb system of highways, the finest in the world, bordered with shoulders of green. America will have her Lincoln way—Georgia must join hands with her sister States in making this road as splendid, as extensive, and as beautiful as any of those which the old world boasts.

THE CHAIRMAN: The determining cause of this women's meeting has just appeared in our midst in the person of Mr. Page. I am sure you will wish to hear him speak although unfortunately the exigencies of a very full program will not permit more than

three minutes even to *the* road man of the country. It gives me great pleasure to introduce Mr. Logan Waller Page, Director of the United States Office of Public Roads and President of the American Highway Association.

MR. PAGE: *Chairman and Ladies:* Mrs. Baker told me she would allow me three minutes to talk to you and I am going to try and make my remarks as brief and practical as possible. I have watched the work that women have done in bettering our rural educational conditions and as President of the American Highway Association, last spring, I asked our Board of Directors to allow me to start a Woman's Department of that Association, for I believe that women could accomplish more in better county road management than men could. For 20-odd years, I have gotten up county and district organizations for the betterment of road management, but they never met with success. A man will get up in his county and say, "everything is all wrong here, we are not spending our money properly, we are not getting any results," but the men will wink at each other and say, "he is going to run for the legislature next year." Now, that's not the case with women.

To try and bring this fact home to you, I will give you an illustration. For the past six years, I have offered each county in the United States a first-class highway engineer, free of charge, if they would let that engineer direct the expenditures of the road fund in that county and to superintend such work and do as he thought best, etc. I have never succeeded in getting but two counties to accept that offer. Now the principal reason is that our road work, our county road work, is superintended by the vast army of some 140,000 road officials, which this lady has just told you about. That system was started in England during the reign of Queen Elizabeth. Oliver Cromwell did away with it in England, but we have stuck to it here. Now as a rule those road supervisors are selected, not because they have any knowledge of road construction but for political reasons—their compensation is too small and their term of office is too short to make it worth their while to qualify themselves, so the result is they are part of a great political machine, that's all. You will find a little account keeping of money on roads will show that work in this direction is not usually done on the most important road, but on the road on which the most important man in the county lives. I succeeded in getting a very rural county in Vermont, three years ago, to accept the services of a highway engineer. We agreed at that time that our engineer should report for duty and remain there a year from the first of May. He reported there on the first day of May and wired me that 80 per cent of the year's appropriation had already been spent. I wired him in return to remain and to go to their commissioner, ask him how much money he had received for road work and to show what work he had done. I told him to make an estimate of what he thought of the work and what it was

worth. He found that $800 or $1000 had been paid to one man, where the work could have been done for $50 or $60. We then held a mass meeting in the county. The people got our engineer to agree to stay there and take the remaining 20 per cent of the fund and see what could be done with it, with the result that never in the history of the country had so much good work been accomplished and the roads were never in as good condition. They finally asked me to let the engineer stay another year and they would let him direct and superintend the expenditures on road work. I let him remain another year. That county is one of the best good road counties in the United States today.

The work that can be done by women in our road work should begin in the counties. Now, very few of us are really familiar with real country conditions. I have called on Mrs. Baker to organize this work, to spread it out into the country and get the real country women to coöperate. We have got to help raise the country out of the rut. I am going to count on the women in this first meeting, where this subject has first been discussed, and I believe the women will accomplish the result we want.

THE CHAIRMAN: The Governor of Missouri has sent as a delegate a woman who has done practical work on roads. She has "bossed road gangs" and superintended the work on the roads near her farm. Though affiliated with many useful movements in her State, she tells me she cares most for her title of President of the Women Farmers' Club. I know we will enjoy hearing a little account of her activities as a "highway man" and a woman farmer. With these titles I have the honor to present Miss Frances Pearl Mitchell, of Rocheport, Missouri.

PRACTICAL ROAD WORK BY WOMEN

MISS FRANCES PEARL MITCHELL
President of the Women Farmers Club, Rocheport, Missouri

You have listened this morning to the aesthetic side of "Good Roads"—the humane side has also been presented. Now I am to tell you something of the practical work done by the women of Missouri.

As far back as 1909 the D. A. R.'s began working for the selection of historic roads as State and national highways. The result was the passage of an "Old Trails Road Bill" in Congress and the organization of a "National Old Trails Road Association" to which were eligible any one interested in historic roads. The Missouri branch of the National Old Trails Road has secured the dedication of a State highway across the Missouri running from Kansas City to New Franklin over the Old Santa Fe Trail—one of the early commercial trails to the unknown West. From New Franklin to St. Charles, the highway follows the Boone's Lick Road—a path made by the pioneer Daniel Boone and his sons when they made their

annual trip to a famous salt spring near the starting point of New Santa Fe Trail. All along this highway of over 300 miles, historic points have been marked by red granite monuments, and in old taverns repairs have been made and relics collected.

The Missouri Women Farmers' Club, composed of women who personally superintend and manage their own farms, realizes the importance of good roads, as a means of reaching the markets, and of keeping in touch with community interests. They are earnest advocators of road improvement and have given much assistance to the work. Some have been interested in the "Good Road's for Child Welfare" association and have organized bands of "Boy Road Scouts" who drag the roads, cut weeds, etc., thus inculcating the interest in good roads in the embryo man. One woman farmer, after failing to interest her men neighbors in the split log drag, gave herself a practical illustration of its use on the roads about her land, which resulted in the community following her example.

When the Governor of Missouri issued a call for two days' road volunteer work, and in overalls and straw hat managed a road grader himself, these women farmers sent their teams and men, furnished lunches for the workers and in every way assisted in the movement. The president of the Women Farmers' Club, a "bachelor maid" found herself one of the official superintendents. The "Bachelor Club" of the town, volunteered to work under her instruction, and a dozen weary, sadder, but wiser, men, before the day ended, realized what it was to be "bossed" by a woman!

A country school teacher in one of the remote counties has proved what can be done with the primitive one-room school house by converting it into a furnace heated, well-lighted building, with a basement equipped with appliances for teaching domestic science. The yard is an agricultural and horticultural experiment field and the boys and girls are organized into squads of road Scouts. She interested her patrons in road work and she and the farm women served dinners at the school house, which has become the community center—so much road improvement has been made that a community wagon gathers the pupils from the farms and conveys them to and from school.

There should be good roads committees in all our Women's Clubs which have any touch with social, civic, industrial or domestic conditions, for whatever women undertake with earnestness or zeal is usually achieved.

Bad roads are a travesty on good government. All nations as they advanced in civilization became road builders. Many of the fine highways of Europe are yet monuments of the greatness of the French Empire under Napoleon's reign. In the Holy Land the tourist and the pilgrim ride their jaded beasts over the broken stony road which the conquering Romans built for their war chariots, over two thousand years ago.

Our own nation has been too busy making history and amassing

fortunes, to build roads, but there is a wonderful wave of road interest enveloping the United States now. The horseless carriage has had much to do with it, for the city and town have common cause, when on pleasure bent. The high cost of living has been another awakener, both consumer and producer realizing that good roads must reduce the cost of food when transportation to market is made easier.

Women can do much by their enthusiasm toward getting the right kind of road legislations and by their demand for the wise and honest expenditure of road funds in their respective States and counties.

Good roads means the uniting of North and South, the East and West into combined effort toward progress and advancement of the Nation!

THE CHAIRMAN: Our next speaker is from Knoxville, Tennessee. She is Chairman of the Conservation Commission and personal representative of the President of the Tennessee Federation of Women's Clubs. I have long anticipated the pleasure of hearing her speak. With great pleasure I introduce Mrs. M. B. Arnstein.

CONSERVATION AND THE ROAD

MRS. M. B. ARNSTEIN OF KNOXVILLE

Chairman of Conservation Tennessee Federation of Women's Clubs

The greatest fact which strikes us when we compare the present day, with the years that have preceded it, is the enormous growth of human power. In this present age, we grapple with everything that pertains to the material prosperity of our country. We know that in facing the various problems of life, that we must consider the forces of nature in all her aspect, moral, economic and social, and in order to cope with this organization of life, we must conserve these forces.

Conservation is the powerful factor in human exploitation. The conservation of our forests, our soil, our water, our minerals, are all of inestimable value. They mean the wealth of the nation, the prosperity of the people, the heritage of the State. With all this wealth at our door; nature's resources o'erflowing in our lap, as it were, the great question is, how to make them available to the world at large?

We must conserve them, but we should do more. We should find a practical outlet for them. How? This problem is best solved by a system of highways and good roads. We may weave garlands of sentiment in our work but in the building of good roads, we are undertaking the practical, which interests and benefits the people socially, educationally, economically.

People everywhere are waking up to the fact that good roads are the prime factor in commercial, social, economical and industrial conditions. The nation is alive to the question and rural life is absolutely dependent upon it.

Good roads have brought a complete change in the whole mental attitude of our fellowmen who conserve the soil. He looks upon life and the world in altered aspect. He too can now conserve, conserve his energy, for he sees before him a long vista of good roads, which means a vista of peace and contentment. No longer must he labor and reap, work and toil against great disadvantages. Distribution can be made easier and cheaper. His products, his industries, can now be readily transported, for his roads are passable at all times of the year. He can haul nearly twice as much on a concrete road as he can on a dirt surface and make the trip to town and back in about half the time. All his perishable products of farm, garden and orchard can quickly be gotten to the market before they spoil. The results are inestimable. The quick and cheap government service, the Agricultural Parcels Post, expand his field enormously. Then, he too, can reckon on the increased value of his land, because of these improvements. Good roads are indeed a potent factor in conservation, they are an economic necessity; for our agricultural communities, our forest industries, our mineral resources are all dependent upon them in an inconceivable measure.

They also mean a conservation of human life and human intelligence. They mean conservation in an educational way for the farmer living in some remote section of the country, hemmed in by muddy roads, cannot educate his family, but against great, trying conditions. The school house surrounded by inaccessible walks, is more a hindrance, than a boon to child life. We must, through good roads, lift these future men and women of our rural and urban districts, from the miry depths of ignorance into the sunlight of knowledge, for no matter how much the State and counties appropriate for educational purposes, this cannot be accomplished unless the children and teachers have good roads.

With good roads, circulating libraries can easily be transported. The people will have their social centers. They can keep in touch with the daily life of the nation, and national opinion will not be restricted.

There is nothing so vital to rural life as good roads, nothing so vital to the welfare of the State and nation, nothing so productive to the development of the country.

The South is a great manufacturing section. Quantities of southern made goods are shipped to all parts of the country, our by-products of the mills, our pure foods, our machinery, our implements are all dependent on good roads. It is the one big question of the day in all lines of industrial endeavor. They will aid not only the rapid transportation of our timber, but will add to the economic utilization of wood and other forest products, and helps us to maintain supremacy of our great mineral production.

Think what they will mean to your marble industries, here in Georgia, to our marble in Tennessee, our coal, our wealth of iron. They mean the upbuilding of the South; the upbuilding of the nation.

Take our forest reserves for instance. We are all in favor of Federal control of our national forests—for our national forests are our greatest asset. The government, as you know, has an option on a tract of 6,000,000 acres in the Southern Appalachian region, in which purchases are to be made, and from which it will conduct its operation by building roads and driveways. What will be the result? This will mean forest institutes and the like, with a system of highways and good roads running through these national forests. The States and counties will construct links in between, thereby making a great highway, extending from near the National Capitol along these mountains to the southern end of the national forests in Georgia and Alabama.

This is coming right home to you my friends. With this system of roads and trails leading down to the streams, all of which we are conserving, with hotels, cottages, etc., there would be made easily accessible one of the most beautiful and picturesque mountain regions in the world.

The country is the nation's great recruiting grounds. What is it that has made the mountains of Europe the playgrounds of America? Why do our tourist spend months yearly in the Alps? Why is it they spend time and money in these foreign counties instead of in their own? Because those people have been far-sighted enough to enhance their natural beauties and to make them accessible by good roads. All over the Continent, will you find highways that make us blush with shame in comparison, public highways, that surpass our private roads and are as beautifully embellished as our city parks.

Good roads are a public health utility. They mean a conservation of life as well as of products, for rural isolation due to bad roads is a serious factor in inflicting disorder of the mind on women. They will mean a diminution of tenement life, for people will realize with good road facilities for transportation, the health giving life of the country.

They mean the reduction of the high cost of living; for our cities are dependent on the country for their products. They mean new life, new hopes, new ambitions.

There is no road so expensive as a bad road, and every county should build good roads; for much money is practically wasted in the process of road building, through inexperience, poor material and poorer labor. There should be greater efficiency in the distribution of funds for public road building, greater efficiency in the supervision. Remember the best is always the cheapest in the end and they who build the best roads, build a road of lasting prosperity. Build a good county highway and every village will have its main streets paved and good roads connecting with it. Pull the suburbs out of its muddy tracks and you will pull them into enlightenment. Give the people good roads and you will not only give them ideals, inculcate a love of home, a pride in their surroundings, but you will conserve the best interests of the people and lay an economic foundation that will benefit the country, the State and the nation.

I was asked "What have women to do with Highways Associations and the building of roads?" I replied, "Women have to do with everything that concerns the home and the future American citizens, and the question of good roads is of paramount importance to home life, to education and to health.

We should make for posterity a better abiding place, "Thy God bringeth thee into a good land, a land of rivers, of fountains, of depths that spring out of mountains and hills." Let us supplement this with a land of good roads, for conservation and good roads are the most urgent questions before the country today. They go hand in hand and will show how human efficiency may be effectively utilized and how many things, that now go to waste, may be converted into sources of revenue.

They mean a new era of prosperity to this country, where poor roads have long been the greatest drawback.

May good roads, foreordained by the wise action of today, be a practical consummation of a glorious tomorrow.

THE CHAIRMAN: "The Social Side of the Highway" is the subject of this next paper. Mrs. Haden was the former President of the Atlanta Federation of Women's Clubs, is now chairman of the Commission on Education of the Georgia Federation and is concerned in much of the good work being done in Atlanta. Mrs. Charles J. Haden.

THE SOCIAL SIDE OF THE HIGHWAY

MRS. CHARLES J. HADEN
Chairman Committee of Social Service, Georgia Federation of Women's Clubs

The road as a social factor may be of greater ultimate value than as a commercial quantity. The church, the school and the neighbor are the first formative influences in the building of the child after it leaves the nursery. The extent to which these may be made effective, very largely depends on the conditions of the roads.

The character of the highway itself is an object lesson which leaves a lasting impress upon childhood. Just as monuments and houses appeal to the childish imagination and suggest standards of life, so does the roadway. Is it well built, well kept, with appropriate bridges and sign-boards?—if so, it speaks thrift and stability, and a deep respect for the home-land. There is more than a surface meaning in the familiar lines "dear to my heart are the scenes of my childhood." A line of great oaks, or elms, that border the roadway imprints a subtle imagery upon the boy or girl that years do not efface. In the upbuilding of rural life, those things which charm and cheer the youth have a solid value which is too often overlooked. The houses, the roads, the fields and other early environment, become unconsciously the standards by which we measure

by comparison like things ever afterwards, whether they be better or worse, at home or abroad. They enter into and become a part of us to an extent that we do not realize until when in mature years we detect how they influence our conduct.

The modern roadway lures the city dweller to the country, creating a counter-current against the call of the foot-lights and the white way. Carried out by motor cars, the educative forces of the city reach the hundreds of homes which were marooned by the old time mud-obstructed roadway. The book, the magazine, the newspaper, the fashion, the miscellaneous emanation which gives sparkle to city life, transforms the one-time monotony of the farm. The drudgery which in former times made dull and drear the farm and drove away from it too many of its boys and girls, is changed by the incoming of labor-saving devices. Through these the earning capacity of the farm is multiplied and the hours of rest increased. Less drudgery and more leisure develops the finer qualities of a people and enriches their social life. These follow the construction of good roads as day follows night.

The rural home-maker finding that city tourists are passing her gateway every hour, naturally yields to the woman's instinct to beautify her surroundings. The custom is both universal and wholesome to add attractive touches when company comes. This initial step of home-pride is followed by other steps of domestic and social advancement. The girl and the boy of the road-side home meeting every day the passing tourists, absorbs elements of a practical education which otherwise would be lost to them.

A rural movement fast becoming nation-wide, is the organization of community clubs. These meet once each month at a home of one of the members, so that during the year, each member has been host at least once, to the club. A study of public questions, of agriculture, of coöperative buying and selling, of fraternal interest, has made these organizations of immeasurable benefit to country life. These clubs are made possible through the winter by good roads; and it may be added that, in hundreds of instances, good roads have been made possible only through the influence of these clubs. These rural clubs, coöperating with each other and with schools of agriculture, have studied the secrets of the soil increasing the earnings of the farmer, and broadening the social opportunities of his family. It has been long recognized that the deep-laid foundations of England's national life are its country homes. The Englishman *lives* by the highway, he merely *sojourns* by the street side. Away from the turmoil of the city and surrounded by the meadows, the Englishman reaches the fullness of his stature in his Thorny Croft, or his Locksley Hall. Under such environment love of the country, is love *for* one's country.

Without the passable roadway we lose our greatest birthright—pure air and abundant sunshine. In the construction of sleeping cars there is a certain scientific minimum of breathing space for

the protection of health; it is equally well recognized that the best protection against social ills are the larger breathing places along the country highways. All deplore the overgrowth of the cities, but this trend of our times seems without remedy. Now, as in the past, the city is reinforced by recruits from the country. The wise thing is to raise the standard from whence these recruits come, not only to better equip those who leave, but to increase the number of those who remain. This is the undertaking for each separate country home and may be best accomplished when country homes, one with another, are close knit into a social fabric. The telephone along the roadside, the metal reservoir conveying water by gravity through every room, electric or acetylene lights, the daily rural mail delivery, the small automobile; these can lighten the one-time burden of the farm and brighten its one-time dullness and transform a whole country into a neighborhood. They follow and depend upon the improved highway. It is not that we need to meet people every hour—indeed it is better that we do not meet them every hour—but that we can meet them when we should and meet them with comfort, that develops social life at its best. Keeping busy at something both useful and agreeable is a later accomplishment of the city woman. This has been found to be the greatest youth-prolonging influence ever discovered. Adopting this discovery the women of the city have united in many organizations for civic and social service. They have served the public well, but in doing so have served themselves better. The highway with its accessions puts at the command of the women of the country the same opportunity of taking the drudgery out, while they still keep busy at something both useful and agreeable. One is work with the sparkle out, the other is work with the sparkle in.

The railway train is of the town and for the town. It steams across the country along its narrow right of way with hardly more of human fellowship than an aeroplane or a meteor. But the improved roadway establishes a *social level.* The humblest cottager feels in it a sense of partnership—that it *leads him somewhere,* and *brings him something.* The school boy with his books, the woman at the well, and the man with the hoe give and receive the salute as the motor car whirls along. The country store and the wayside inn, give and take the glad hand with the tourist. Between the driver on the hay-wagon and the millionaire in his touring car the pure democracy of the pioneer republic for the passing moment lives again. In touring across New England during the past summer, the cottage woman who kept the toll-bridge which spans the Connecticut River where it divides the mountains of Vermont and those of New Hampshire, told us that within two hours that day she had talked with tourists from Canada, New York, Texas and Georgia. With two small children clinging to her skirts she said to us, with a goodbye wave of the hand, "You know, we are all neighbors now."

It is one step—a kind of graceful, sliding scale—by which the

tree-bordered avenue stretches into the tree bordered country road. The reasons for the one are the reasons for the other. Beauty, comfort and relief from monotony. The cost of planting and keeping shade-trees along the highway is hardly perceptible. Sunshine and clouds give like spendthrifts, the blossoms of spring and the brown leaves of autumn are semi-annual dividends declared by mother nature, and the added growth as year follows year, is the ever increasing patrimony which one generation bequeaths to another. Such will be the highways of the future as the women of our land become more and more concerned in its outdoor civic welfare and cause our road-builders to reckon on the commercial value of beauty. In France and California, the charm of the roadway attracts tourists from all parts of the world, tourists who spend unsparingly of their money and their time.

As a beautiful gown calls for appropriate accessories until the ensemble is complete, so will the shade trees of the highway call to their support the grassy lawn, the rose garden, the artistic touches of house and out-buildings, until the domestic scene has been made anew. The modern roadway will lead us back to the social supremacy of the country as it is in England and as it once was in the old South; and these things are coming as by the swift speed of the motor car, city comforts are carried to the country home.

In the pioneer days, the winter solitude of the country was severe in the extreme. The farm home from December to March was but little more of a social center than was the island of Juan Fernandez, with Robinson Crusoe and his man Friday. Mud put an embargo on travel, except when under compulsion, for a hundred days of the year. It must have been when looking from a farm house window upon a January landscape of gloom and chill, overhung with lowering clouds, that the great author wrote "Now is the winter of our discontent."

It has been these "winters of discontent" that has driven much of the best citizenship of the country into the towns, during the past two generations, an exodus causing a melancholy decline in many parts of American country life.

The trolley car, many years ago, began the extension of urban boundaries; then came the automobile putting further from the soot and noise, the home of the city family. Now, in the more thickly populated States, where the towns are near, it is hard to tell where the city ends and the country begins. The business man indulging in his fondness for amateur agriculture, is helping the fortunes of the real farmers on the adjoining farms. A comradeship has grown up among these new neighbors; the man of the city is absorbing the thoughts and habits of the country; and the man of the country is taking up the thoughts and the habits of his city friend. It is a new social melting pot, out of which we are moulding a vigorous manhood. The tension upon the man from the office is loosened, and the man at the plow acquires a more definite aim and

precision of purpose. The drudge worn look of the farm house gives way to the shrub, the vine, the varnish and the paint, and the woman of the farm house is refreshed by the thought that she is in touch with the world.

The wayside home is passing through a period of transition. Science is softening the hardness of farm life. The work remains, but the toil is growing less. By telephone, the house 10 miles distant is nearer in wintry weather than the town neighbor several blocks away in former years. By the motor car, 5 miles is closer the railway station, than by horse drawn vehicle over a bad road 1 mile.

In Baltimore, within the last few years, the old aristocratic quarters of the city have been practically abandoned, because the residents have built their homes from 5 to 15 miles away, mingling country seats with farms. The grassy lane has become an avenue, and the old post roads widened into boulevards.

History has placed in the first rank the men who build cities. But in modern times too much city has disturbed both our social and economic equilibrium. The man of the hour—the hero of the day—is the man who builds a country. The magician of our times whose miraculous touch restores the poise between city and country life is the road-builder. It is he who is strengthening the social ties, and is making a neighborhood of a nation.

THE CHAIRMAN: It gives me much pleasure to introduce Mrs. Sheppard Foster. Mrs. Foster is the former State regent of the Daughters of the American Revolution and represents the National Old Trails Road Committee of that great organization.

NATIONAL OLD TRAILS ROAD

BY MRS. SHEPPARD FOSTER

I appear before this Good Roads Conference in behalf of approximately 100,000 women, the Daughters of the American Revolution, and as the representative of Miss Elizabeth Butler Gentry, National Chairman of the Old Trails Road Committee, who extends best wishes to this conference and regrets exceedingly she cannot be present. As her deputy I take pleasure in bringing to your notice our bill, introduced by Mr. Borland, January 15, 1911, known as the Daughters of the American Revolution Old Trails Act or H. R. 2864. This bill provides for the construction of a National Old Trails Road—the ocean to ocean highway proposed as a national memorial road by the National Society of the Daughters of the American Revolution. We seek your support and coöperation for this measure for you know it has been said "What woman wishes, God wills."

In 1910–11 Mrs. Robert Oliver, State Regent of Missouri, appointed Miss Elizabeth Gentry of Missouri, Chairman of the State Old Trails Road Committee, whose duty it was to urge a State

highway across the State following two famous old trails. At Miss Gentry's request Governor Hadley of Missouri dedicated this road and named it the Old Trails Road. Miss Gentry is now chairman of a national committee in the Daughters of the American Revolution, 1000 strong, representing every State in the Union, actively engaged in creating public sentiment for this road. Through the courtesy of the Century Company, the Madonna of the Prairies, renamed the Madonna of the Trail, has been adopted by this committee as its symbol.

Already this ideal and sentimental project, initiated and organized by the Missouri Daughters of the American Revolution, has been endorsed by the Trans-Mississippi Congress, the Association for Highway Improvement, the National Old Trails Road Convention, the American Road Congress, and the United Daughters of the Confederacy. The National Old Trails Road Association was formed at a national convention at Kansas City, April, 1912. As stated in its By-laws, it was "formed to assist the National Society Daughters of the American Revolution to carry forward its purpose of making the National Old Trails Road the National Highway." This organization of men has over 7,000 members and handles the business and practical side of the question while the Daughters of the American Revolution handle the historic and sentimental side. Judge J. M. Lowe, of Kansas City, is President of the Association.

The Daughters of the American Revolution were the first to think of a national memorial highway, spanning the continent. In each State they are trying, as we are here in Georgia, to preserve by means of good roads, the local history. But they are all concerned together in the preservation, by the National Old Trails Road, of the history of our country. Now is the time when a great scenic and historical highway will do most for America for the reason that at present Americans must stay at home and "see America first." There are many road bills pending in Congress and we admit the necessity for all of these diverging highways. Nevertheless, because our great road in the next few years will have an unprecedented opportunity to teach American history to Americans and because we claim priority for the idea of a transcontinental highway we want our great ocean to ocean road built *first*.

Our organization has for one of its laudable purposes "to aid in securing for mankind all the blessing of liberty." Is it not doing this by advocating a bill for a national highway from ocean to ocean, not only teaching our country's history to natives and foreigners alike, but thereby securing the betterment of country life? Our plan has a social and political as well as an economic value, for our road is made up of several old trails that speak one by one of the advance of opportunity, civilization, religion and romance, across our continent.

This road will also make accessible our beautiful American scenery. It is estimated that approximately from $250,000,000 to $300,000,000

is left annually in Europe by Americans—no doubt more than this amount was left this year. We have a great opportunity now to keep our people at home, so why not make home as attractive as other countries? The Swiss Alps, with its picturesque lakes, do not eclipse the grandeur of our Wyoming and Colorado scenery, and Yellowstone Park, with its phenomenal geysers and other beauties, and the Grand Canyon of Arizona have no rivals.

It is the purpose of each State, through which this road passes, to make it typical of that State, not only by bringing attention of the tourists to the history of the State, but to where native animals, trees, etc., may be seen; to State museums, where objects of local interest are collected and preserved; and to old taverns of coaching days. This road has been called "Peacock Boulevard," but along this boulevard you may not only see (may I say) beautiful "peacocks," but "you can delight in the canvas back ducks and oysters of Maryland, the beaten biscuits and fried chicken of Virginia, the Missouri apple, the Kansas corn and the venison steak of the Northwest as well.

The outline of the National Old Trails Road you will find traced across this map. Here are the old Washington Road, the old National Road or Cumberland Pike, the Boon Lick Road, the Santa Fe Trail, Kearney's Road and the Oregon Trail. The Washington Road was traversed by General Washington to and from his several inaugurals as President of the United States and the Braddocks Road was traveled by General Braddock in his campaign against the French and Indians in 1755. The States crossed by these pioneer trails are Virginia, Maryland, Pennsylvania, Ohio, Indiana, Illinois, Missouri, Kansas, Colorado, New Mexico, Arizona, California, Nebraska, Wyoming, Idaho, Oregon and Washington. The road is open all the year, and is even now ready for tourists to the Panama Exposition. There are hotels and garages the entire length of it, easily reached during each day's travel. The larger portion of it is now a dirt road, with concrete bridges and culverts. When the government takes it over it will be macadamized or concreted.

Modern travel demands clear road signs to mark the roads and travel goes to the well graded and well marked roads. The sign for our Main Road is composed of red, white and blue bands, each four inches wide and eight feet from the ground. It is surmounted with the Daughters of the American Revolution Insignia and the name, National Old Trails Road.

I have given you briefly an outline of the proposed National Highway of the Daughters of the American Revolution, and I wish particularly to impress upon you that in doing so I am simply the mouthpiece of the national committee. The committee wants your support because this Old Trails Road is the most practicable outline for an ocean to ocean road yet suggested, because its connection links are made up of old roads and trails that are replete with history, and because there cannot be a route which would be of more picturesque and historic interest.

The old roads have been marked with the crimson blood of our forefathers who through their heroic deeds and sacrifices, blazed the pathway of American civilization and their history is filled with sacred reminiscences. The Daughters of the American Revolution ask you to lend your influence in behalf of our Old Trails Road Bill as a fitting memorial to our pioneer patriots.

THE CHAIRMAN: After such an interesting paper it is rather difficult to explain the attitude of this new woman's department to these specific highways. Especially after the delicious *menu* offered by the National Old Trails Road! This department, of course, is heartily in sympathy with good roads everywhere that they serve the demands of present day traffic and is deeply sensible of the charm of sentiment and association which clings about the old trails. These transcontinental highways and all others ought however to be built by skillful men, under efficient and economical management, and all the various sections of these costly roads should be permanently maintained after they are built. Under our present State systems of road management from 20 to 40 per cent of the road funds are wasted. How much better to stop this enormous leak before pouring out further great streams of money for the roads.

The Woman's Department begs the assistance of all patriotic women to make our road management as efficient as the management of any other big modern business. Then there will be money enough in State treasuries to build the different sections of these splendid roads at the smallest cost and with the least expenditure of time and effort.

It is much to be regretted that the fine addresses of Mrs. Nellie Peters Black of Atlanta, Mr. Sidney Suggs, State Highway Commissioner of Oklahoma, Mr. Wm. R. Roy, State Highway Commissioner of Washington, Mr. J. E. Pennybacker, Chief of the Division of Road Economics of the U. S. Office of Public Roads and Professor Agnes Ellen Harris were not reported. Mr. Pennybacker, who officially represented the Office of Public Roads of the Department of Agriculture, gave an illustrated address showing how women can best aid the movement for better roads. Miss Harris who is the leader of the Canning and Poultry Club work of Florida and professor of Home Economics in the Florida State College for Women, officially represented the farm demonstration work of the Department of Agriculture at the Women's Conference on Roads. The subject of her very delightful address was, "The Road, an Opportunity."

ANNUAL MEETING OF THE AMERICAN HIGHWAY ASSOCIATION

ATLANTA, GEORGIA

November 12, 8 P.M.

President L. W. Page in the Chair.

The meeting was called to order by the President, and the minutes of the last meeting read and approved.

The Secretary presented his report for the year, and also the report of the Treasurer, the latter official being absent. The Secretary reported that 520 new members had joined the Association since its last meeting; that a most important step had been taken in the establishment of a Woman's Department, and that the financial affairs were in an unusually satisfactory condition, there being a balance on hand of $6,868.26. He also reported that the 1914 edition of the Good Roads Year Book and the Proceedings of the Third American Road Congress had been issued during the year, distributed to members of the Association, and a large number sold.

On motion of Mr. MacDonald, duly seconded, the reports of the Secretary and Treasurer were approved.

THE PRESIDENT: Gentlemen, there is an amendment to the constitution to come up for action tonight, of which due notice has been sent you by the Secretary. I will ask Mr. Pennybacker to read the amendment.

SECRETARY PENNYBACKER: Mr. President, the purpose of the amendment is to make all officers except President, Vice-President, Treasurer and Directors, appointive by the Executive Committee. The amendment, if adopted, will read as follows:

Article V (as amended)

Section 1. The officers of this Association shall consist of a President, a Vice-President, a Treasurer, and a Board of Directors, consisting of the President and Vice-President of the Association and twenty-three additional members, to be elected at the annual meeting of the Association as hereinafter provided, and such other executive officers as may be appointed by the Executive Committee.

Section 2. The President, Vice-President, Treasurer, and members of the Board of Directors shall be regular or sustaining members of the Association, and shall be elected at the first regular meeting and annually thereafter, except that the members of the Board, exclusive of the officers, shall be elected in three groups, the first to hold office for a period of three years, the second to hold office for a period of two years, and the third to hold office for a period of one year, vacancies on the Board to be filled annually thereafter.

On motion of Mr. Diehl, duly seconded, the amendment was adopted.

THE PRESIDENT: Gentlemen, the next business before the meeting, is the election of officers for the ensuing year.

MR. J. E. PENNYBACKER: Mr. President, I move that a nominating committee of seven be appointed to consider nominations and bring in a list of nominations for all officers and directors to be elected at this time.

The motion being duly seconded and carried, the President appointed the following committee on nominations: Messrs. Parker, Diehl, Suggs, Beatty, Mehren, Pierce and Rader. The committee then retired.

THE PRESIDENT: While our Committee is conferring, I wish to say to you that I appreciate in the highest degree, the splendid support that you have all given to our work of the last four years. I think a great deal has been accomplished. One of the most far reaching results which our meetings have been instrumental in bringing about, was the formation of an organization of State highway officials. There are so many people throughout the country that have helped in the work during my term of office that it would be impossible for me to thank each by name, but I take this occasion to express my deep appreciation of this splendid coöperation. I might mention another project of importance that we have inaugurated this year, and that is the formation of a Woman's Department of the Association. We all know how deeply the women have stirred the public mind in their propaganda for prohibition and suffrage, and I believe that an equal amount of energy exerted by women to bring about better road management throughout the United States, will be most productive. We all know that if a man begins to talk reform in road work in our counties, the men smile and say he is going to run for the legislature next year or for Congress. Now that is not the case when women take up the work. I have asked the women who have engaged in this work, in organizing their respective counties, to take up three questions; how much money are we spending in our county on roads; where are we expending this money; and, how are we expending it? I think if these three subjects are seriously considered in our counties, we will ultimately accomplish a great deal in the way of results. I see Mr. Fletcher of California, President of the Congress here, and I know we should all like to hear something from him.

MR. FLETCHER: That is a very sad joke; I can't make myself heard, because of my hoarseness. You will have to excuse me.

MR. BOORMAN: I think we ought to hear from our friend Smith in regard to your splendid remarks on this women's work. Mr. Smith helped in inaugurating their first meeting. I only regret

that the press of the country have not heard the magnificent speeches by those noble women.

MR. PRESIDENT: We would like very much to hear from Mr. Smith.

MR. SMITH: I think that Mr. Boorman had better continue the argument himself. I said in my speech to the good ladies that I thought it was a great day when you organized that department to get the women of the country interested in road building, and eliminate the political side of the question. I am sure that their efforts will bring substantial progress in road building. Women are the leaders in almost everything else. They are taking a great hand in education, they know how to do things in detail much better than men, and I am sure you haven't done anything in all your adm'n strative actions greater than the establishment of this department, and I look for great results, if maintained and worked out along the lines that you have suggested. I wish we could get the benefit of them in Goergia. I hope that the Georgia women will take up this question and find out, as you suggest where we are spending this money and for what? In my own State, I find that great sums are being wasted. We have no organization. We are all acting independently of each other and with no definite system. We should have a Highway Commission whose knowledge would help us to get results. The State of Georgia gives us 5000 convicts to work, but mark you, we have not learned how to work them to the best advantage. We want engineers who can figure out some material along our roadsides that we can put into our roads and make a winter road. I wish, at your next Congress, that you would devote more time to this question of material. We are relying now on Professor Strahan, from the State University, to give us the information and he has helped us wonderfully.

MR. PRESIDENT: Gentlemen, this year we lost one of the greatest men, in my judgment, who has ever been connected with the road movement. I know when I first took the subject up and we decided to form our organization, I went to Mr. Alfred Noble, whom I consider one of the greatest engineers this country has ever produced, talked the situation over with him and he urged me to proceed with the formation of this organization. From the very inception of the work he gave us valuable advice and generous financial support. I think it was the darkest moment of our existence when he died. I know I felt his loss very keenly and I hope that one of you will move to appoint a committee to draw up suitable resolutions upon the death of Mr. Alfred Noble.

MR. BOORMAN: I attended the funeral services of that great engineer held in the Cathedral of St. John, on Morningside Heights, surrounded with everything that was beautiful, everything that

was lovely, everything that was uplifting. I met there gentlemen like our distinguished friend the city engineer of New York, men well advanced in life came up to pay their last respects to the memory of Alfred Noble. I feel that I can say and we can all say that Alfred Noble was called to his eternal rest after a life that could not be more full of noble and great works. To men like him we must look up and try, if we can, to emulate their noble acts. It is most eminently proper that a committee should be appointed to draw up suitable resolutions in memory of our great engineer, and I move, Mr. President, that a committee be appointed.

MR. PRESIDENT: We have also, during the past year, lost another member of our Executive Committee, Mr. W. W. Finley, President of the Southern Railway Company. It was Mr. Finley who first urged me to start this association, and to the day of his death was one of its strongest supporters. I hope that the motion will include both Mr. Noble and Mr. Finley.

MR. BATCHELDER: Mr. President, I make a motion to that effect.

The motion was seconded and adopted.

MR. PRESIDENT: Gentlemen, I will appoint on that committee Messrs. Charles Whiting Baker, Wm. D. Sohier and A. B. Fletcher. I see right in front of me my old friend Commissioner MacDonald of Connecticut, and while we are waiting for the committee on nominations I hope he will give us a few words.

MR. MACDONALD: *Mr. President and Gentlemen of the Association:* I think it would be highly proper for me at this time to endorse the new auxiliary to our work, the ladies. I know that in the early days of my struggles as highway commissioner the most valuable assistance that I had in my town meetings throughout the State where the propaganda had to take place, was the ladies. It was a sort of house party, and I know in one little township the young ladies gave a minstrel performance. They blacked up and attracted a purse of some $800 with which they built walks all through the village. The young men sought to emulate their example and got up a show, but they didn't get but $400. Now, over in my State, if we want to lift a mortgage on a church, we appoint a committee of ladies and we worship God in a house without debt. If the horse shed leaks, we don't have any trouble about getting a dry roof when we appoint a committee of ladies to take care of it. Mrs. MacDonald went to this ladies meeting the other day, and has attended some of the sessions here that we have had this week. She said she wished that the delegates could have been present at that meeting of the ladies and heard them discuss this great question of highway improvement. The dispatch with which they took care of the business of the hour and the comprehension that the ladies show in regard to this great question, would, she said, have been a

great lesson to us, not only in the conduct of our convention, but also in the subject matter discussed. I told her I rather thought that was a lady's point of view, but she said she was sorry I had not been there for I would have had the same opinion. I believe that our organizations, throughout the country, for highway improvement would be materially strengthened if we had the ladies join the organization. The great thing that we will have to contend with, gentlemen, in the future, in my judgment will be predatory interests, commercialism and politics, as the most destructive force in highway construction. Poor construction will not begin to have the influence in comparison with the three things which I have mentioned. This Association and all other associations that have to do with this great question, need to be intrenched, organized deeply. There is no doubt but what the splendid session that we had the other day on the merit system is one of the greatest questions of the hour. We should have it. One of the greatest assets of that splendid organization the A. A. A., is that they are loyal and faithful, have a united interest, and are one for all and all for one. There should be one great organization throughout this country that should have for its purpose the keeping of men in office irrespective of politics or any other influence that you might name, just so long as they are worthy and well qualified to fill the position. It is not enough to have all the money that is necessary with which to construct roads, it is not enough to have executive ability to organize a great force, it is not enough for me to know how, but greater and better than all, is the question of economics, how to spend every dollar so that there will be an equivalent for that dollar which you have expended. I am very glad to see this great organization that we have indoors and outdoors, with all their tools and implements and material. We need every one of them, and I am very glad to notice that today and yesterday there was some attention paid to this great question, the foundation of road building, the dirt road, the question of drainage, the question of grading, the width of road, the cycle, the question of straightening a road and all those auxiliaries, and this, gentlemen, right here in Georgia where you have 82,000 miles of road and 52,000 square miles of territory and just 4800 miles of improved highways. What are you going to do with the rest of them, the dirt roads? There is not enough attention paid to the little details of road building; there is too much attention paid to the question of refinement; what you want just now is a deeper insight into the little things, the depth of the road. We very wisely saw that with only 10 per cent of the highways of this country improved and 90 per cent still lying in the mud, that it was a great question how to take care of that vital problem of starting with the earth roads, and what you want to learn is how to properly incorporate the clay and the sand and wait until the day comes when you can take up the higher branches. In my own State I had a thousand dollars which I had to divide into eight parts, and I remem-

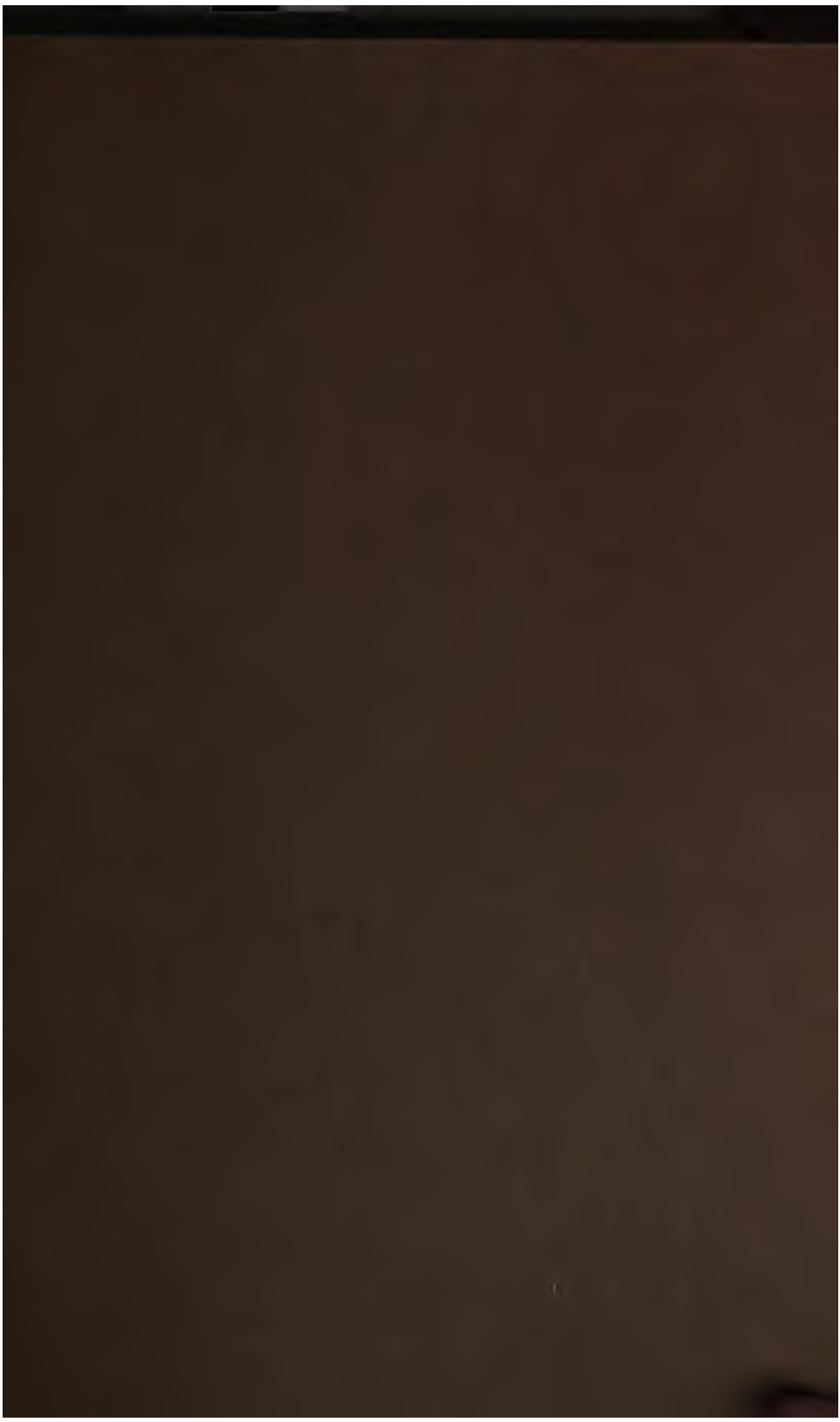
ber going out and pacing over the road without even a tapeline and then sitting down on the side of the road figuring it up and letting it to the selectmen of the town to do it, and was severely taken to task by some of the engineers on the ground that I was interfering with their business. I said, "Watch me, boys; they only had $1000, in some places, and $500 in others, and you will see they will come into the movement." The next year 32 of those townships came in for $9000. That was the result of starting with the little ones. We cannot all have jewelry for our wives and so it is going to be all through this great country of ours. The vital question for us all to take up is, let us do whatever we have to do with our hands with all out might and have an eye single to what is best all over the country, and let us see to it that we stand together for honesty of purpose and good intelligent management of everything that may be placed in our hands. I thank you.

Mr. Fletcher takes the chair.

At this time the committee on nominations submitted the following report: for President, Fairfax Harrison; Vice-President, Logan Waller Page; Treasurer, Lee McClung; Directors for three years, A. G. Batchelder, Bryan Lathrop, W. Tom Winn, Charles E. Blaney, William D. Sohier, S. E. Bradt, and Richard H. Edmonds; E. J. Mehren to fill the vacancy caused by the resignation of Jesse Taylor whose term would have expired in 1915.

On motion of Mr. Batchelder, duly seconded, the report of the committee was adopted and the Secretary directed to cast a unanimous ballot for the election of the officers named.

No further business appearing the meeting adjourned sine die.



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